Registered at the G.P.O. for Transmission to Canada by Magazine Post.

Vol. 48. Ser. A. Part 7. pp. 277–316. JULY, 1960

THE REVIEW OF APPLIED ENTOMOLOGY

SERIES A: AGRICULTURAL

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
56, QUEEN'S GATE, S.W.7

Price 6s. net

Commonwealth Agricultural Bureaux

EXECUTIVE COUNCIL

A. Perera, *Chairman*, Ceylon.

C. K. Reheem, *Vice-Chairman*, Pakistan.

W. G. Alexander, C.B.E., United Kingdom.

J. G. Malloch, M.B.E., Ph.D., Canada.

E. J. Drake, Australia.

V. Armstrong, Ph.D., New Zealand.

J. F. Brooks, Union of South Africa.

S. Krishnamurti, India.

W. W. K. Vanderpuye, Ghana.

J. D. de Silva, Federation of Malaya.

J. E. C. Coventry, Federation of Rhodesia and Nyasaland.

C. E. Lambert, C.M.G., Colonial Territories.

Sir Herbert Howard, *Secretary*, Farnham House, Farnham Royal, Nr. Slough, Bucks.

COMMONWEALTH INSTITUTE OF ENTOMOLOGY

Director and Editor

E. O. Pearson, M.A.

Assistant Director

R. G. Fennah, M.A.

Assistant Editor

R. F. Avery, M.A.

Head Office—c/o British Museum (Natural History), Cromwell Road, London, S.W.7

Publication Office and Library—56, Queen's Gate, London, S.W.7

© *Commonwealth Agricultural Bureaux, 1960*

THE INSECT PESTS OF COTTON IN TROPICAL AFRICA

by E. O. PEARSON

Director, Commonwealth Institute of Entomology, formerly Senior Entomologist, Empire Cotton Growing Corporation

Bound in cloth. Royal 8vo. Pages x and 355, 8 coloured plates, 16 text figures and over 750 references.

Price 40s. post free

Cotton is one of the most important crops cultivated in tropical Africa and no comprehensive account exists of the numerous pests that attack it in that continent. The present work provides a concise and critical résumé of the available information, formerly scattered through the literature, to which a full bibliography is given, and much hitherto unpublished information is also included.

The book contains two introductory sections, the first dealing with the structure of the cotton plant and the background to its cultivation in tropical Africa, and the second giving a general account of cotton pests as regards the systematic groups to which they belong, their geographical distribution and the nature of their association with cotton, together with a summary of what insects and diseases affect the different parts of the cotton plant in Africa, and a discussion of the effects of insect attack on yield. Brief notes are given on each of the cotton-growing areas in Africa south of the Sahara and their principal pests. There is a key to the disorders affecting cotton in Africa, based on symptoms visible in the field.

The main section of the book consists of an account of each of the more important pests, dealing with the taxonomy and distribution, appearance of the different stages, life-history and seasonal activity, nature of the damage inflicted on cotton, alternative host plants, natural enemies, factors affecting prevalence, and control. In the case of species or groups that are not confined to tropical Africa, relevant matter available from research on them elsewhere is included.

Obtainable from:

The Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7.

ENTOMOLOGICAL LITERATURE

NEW AND SECONDHAND

Large stocks of Separata and Reprints on all Orders and Entomological subjects

CATALOGUES SENT FREE ON REQUEST

E. W. CLASSEY, F.R.E.S., A.B.A.

Entomological Publisher & Bookseller

4 Church Street, Isleworth, Middlesex, England

BULLETIN OF ENTOMOLOGICAL RESEARCH

The Commonwealth Institute of Entomology also publishes the **Bulletin of Entomological Research,** issued quarterly and containing original articles on Economic Entomology. The Annual Subscription, *in advance,* is **100s. post free.**

Back Volumes may be obtained as follows:—

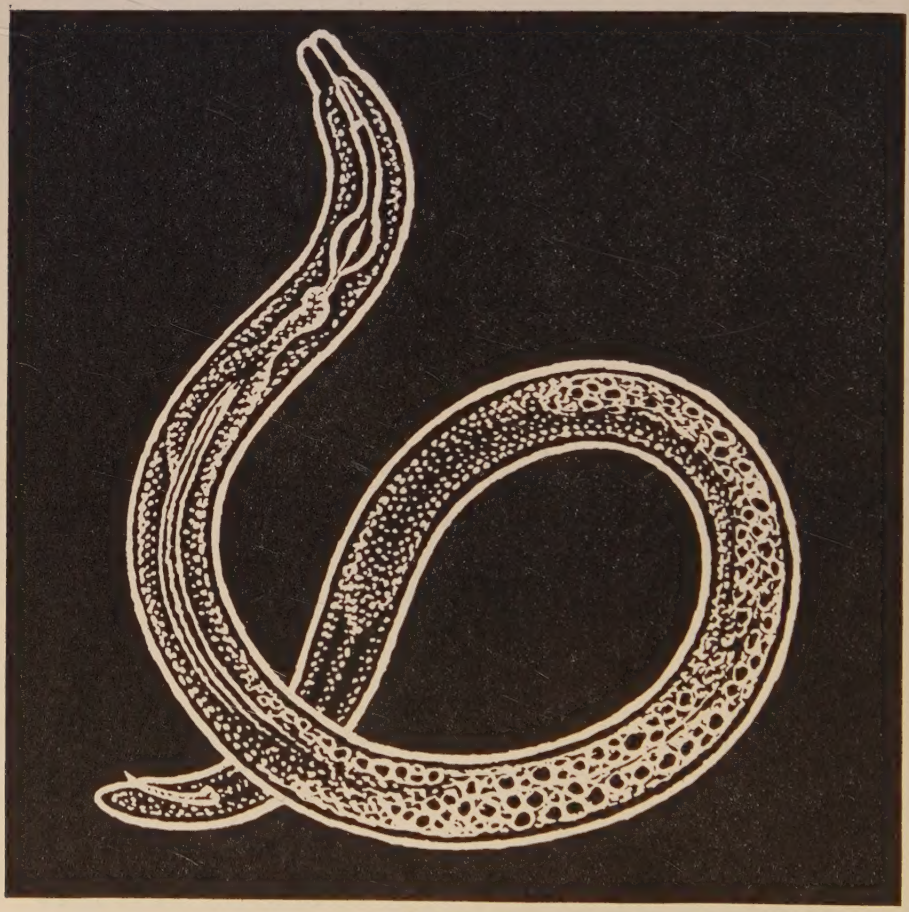
1–10, 40s. each.	**24–38** .. 60s. each.	*Post Free.*
11–23, 50s. each.	**39–47** .. 85s. each.	*Post Free.*
	48 *et sqq.* 115s. each.	*Post Free.*

Orders and subscriptions should be addressed to:—

Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7

Meloidogyne spp . . .

. . . one of the most numerous of the nematode pests that attack crops throughout the world (and here shown 425 times life size). Fortunately, treatment with D-D Soil Fumigant provides a sure method of control. Being a pre-plant nematocide, D-D is ideally suited for use on annual crops where root-knot nematodes are a serious menace. Shell D-D is easily applied and one treatment lasts the whole growing season. Its use results in marked increases of yield and quality in crops such as tobacco, pineapples, vegetables, ornamentals and tree nurseries. **D-D**



YOU CAN BE SURE OF SHELL CHEMICALS

SHELL

Issued by Shell International Chemical Company Limited.
For further information consult your Shell Company
(in the U.K., apply to Shell Chemical Company Limited).

Vasiljević (L. A.). **Patogeno dejstvo nekih vrsta bakterija na dudovca (*Hyphantria cunea* Drury).** [Pathogenic effect of some species of bacteria on *H. cunea*.]—*Mem. Inst. Pl. Prot.* no. 7, 79 pp., 29 figs., 75 refs. Belgrade, 1957. (With a summary in English.)

In tests in Yugoslavia, 11 species and strains of bacteria were tested for pathogenicity to the immature stages of *Hyphantria cunea* (Dru.). The only ones that killed larvae that fed on contaminated leaves were a species of *Bacillus* from *Tibicen* (*Cicada*) *plebeja* (Scop.) received from France, *Bacillus cereus* var. *alesti*, isolated from *Bombyx mori* (L.) in France, and *B. thuringiensis* from *Anagasta* (*Ephestia*) *kühniella* (Zell.) in California, all of which gave complete mortality in 3–5 days. Soaking the pupae in bacterial suspensions caused no kill, and though moistening the eggs with them did not prevent hatching, larvae from eggs treated with the above three strains all died in 1–2 days. The first of them also gave good control of fourth-instar larvae when applied in sprays to trees in a field test, though mortality occurred rather more slowly than in the laboratory. The histopathological changes induced by infection are described.

Dolinka (B.). *Laspeyresia compositella* **F. a lucernamag ujabb kártevője Magyarországon.** [*Cydia compositella*, a new pest of lucerne seeds in Hungary.]—*Fol. ent. hung.* (N.S.) **12** no. 19 pp. 263–274, 4 refs. Budapest, 1959. (With a summary in English.)

Cydia (Laspeyresia) compositella (F.) is common in parts of Hungary and is injurious to lucerne, on which the larvae feed on the buds, flowers and seeds. The damage ranges from 3 to 43 per cent., depending on the age of the crop, and clovers are also attacked. The adults are present from the end of May or the beginning of June until mid-August and are active at night. The females oviposit 4–6 days after emergence, laying 1–2 and sometimes 3–4 eggs per leaf. The larvae hatch in 4–6 days, pass through five instars and pupate in the soil. The prepupal stage lasts 6–10 days, and the pupal stage 7–13. There is one complete generation and a partial second in the year, and pupae are present in the soil from mid-June to mid-August. Several insecticides, including BHC, applied in dusts at blossoming time, gave effective control.

Săvescu (A.). **Die Linden-Kommaschildlaus (*Lepidosaphes tiliae* sp.n.).** [*L. tiliae*, sp.n., on *Tilia*.]—*Anz. Schädlingsk.* **30** pt. 12 pp. 197–201, 11 figs. Berlin, 1957.

Lepidosaphes tiliae, sp.n., all stages of which (including the winged males) are described, was first observed in 1945 on lime (*Tilia*) in Bucharest and occurred in 1946–55 on this tree in several localities in the Bucharest, Ploești and Cluj regions of Rumania. The Coccid infests the bark of the trunks and branches, causing desiccation and, if numerous, falling of the buds and die-back. In tests, no other trees were infested. There is only one generation a year. The eggs overwinter under the scale of the female, resume development at the beginning of April, at temperatures averaging 9°C. [48·2°F.], and hatch during the first ten days of May. Laboratory tests showed that at constant temperatures of 27 and 21°C. [80·6 and 69·8°F.], the eggs hatched in 15 and 18 days, respectively. The first

nymphal instar lasted 15–20 days, the second-instar nymphs fed for 14–16 days, after which differentiation between males and females began, and male and female adults appeared in a further 5–6 and 7–8 days, respectively, usually in the first ten days of June. The ratio of males to females ranged from about 1:1 to about 2:1. The females fed after pairing and oviposited for about 35–45 days from about 10th July, during which time they laid 50–110 eggs each. Differences in morphology and bionomics between *L. tiliae* and *L. ulmi* (L.) are shown in a table.

Normal winter sprays were ineffective in tests against *L. tiliae*, but 97·5 and 96·4 per cent. mortality of nymphs was given in 1951 by 1 per cent. summer oil emulsion and 0·2 per cent. parathion, respectively, applied two weeks after they appeared. Treatment with lime-sulphur at 0·3 per cent. or nicotine at 0·2 per cent. was also effective, but required two applications, 10 and 20 days after the appearance of the nymphs.

EIDMANN (H.). **Ein Anobiide, *Dryophilus pusillus* Gyll., an der Lärche.** [An Anobiid, *D. pusillus*, on larch.]—*Anz. Schädlingsk.* **30** pt. 12 pp. 201–202, 1 fig., 4 refs. Berlin, 1957.

Dryophilus pusillus (Gylh.), which occurs from the Caucasus to southern Scandinavia and of which the bionomics were unknown, was recently found infesting larch (*Larix decidua*) in four places in central Sweden, where it is known to occur as far north as the Uppland district, to the north of Stockholm. Observations in 1957 showed that the larvae of the Anobiid fed first at the bases of buds on short shoots and then hollowed out the entire bud. They overwintered in any of the last three instars, but predominantly in the last, and resumed activity in the first half of May. Probably most, but not all, pupated in summer, pupation taking place in a chamber in the hollowed-out shoot at the base of the bud, and the pupal stage lasted 10–14 days indoors and probably not much more in the field. The adults remained in the pupal chamber for a day or two after emergence and were observed from the beginning of June to the end of July. Examination of short shoots in 1957 showed that none of those formed in the two preceding years were infested, but that 9 and 8·5 per cent. of those of 1954 and 1953, respectively, and 1·9 per cent. of those of earlier years were. Up to 24th July, the corresponding percentages of short shoots that had died were 43, 53 and 70 (none of those of 1955–56 being affected). The percentage of dead shoots that were infested with living insects decreased rapidly with age, and it appears that the larvae attack the living shoots and are not merely secondary pests.

v. SCHELLER (H. D.). **Versuche zur Bekämpfung von *Coleophora laricella*. Ein Beitrag zur Wirkung von Kontaktinsektiziden auf die Kronenfauna.** [Tests on the control of *C. laricella*. A contribution to the effect of contact insecticides on the crown fauna.]—*Anz. Schädlingsk.* **30** pt. 12 pp. 203–207, 3 refs. Berlin, 1957.

Insecticides were tested in 1954–56 for control of *Coleophora laricella* (Hb.) on larch near Hanover, and mortality of other arthropods present in the crowns of the trees was also noted. In 1954, a dust containing 2 per cent. methyl-parathion (E 605 Staub) was applied on 6th–9th September in a stand of trees 15 years old consisting of European larch [*Larix decidua*], Japanese larch [*L. leptolepis*] and hybrids of these,

infested also by *Taeniothrips laricivorus* Krat. & Farský [*cf. R.A.E.*, A **48** 87], in order to kill the larvae before they caused discoloration of the needles. The trees had long been infested by *Coleophora*, with the result that the hybrids had been severely stunted. Some rain fell during the treatment period. In another area, the trees were treated with a preparation containing malathion. Dead arthropods were collected after treatment on sheets of paper spread on the ground, and lists of them, showing the numbers of each, are given. They totalled 5,330 individuals collected in an area of 24 sq. yards in a period of 6–79 hours after treatment with methyl-parathion, and 215 in one of 48 sq. yards in a period of 22 hours after treatment with malathion. Mortality of the larvae of *Coleophora* on the shoots was over 90 per cent. for methyl-parathion on 13th October and only 6–73 per cent. for malathion. In the stand treated with methyl-parathion, where treatment at the edges had not been as thorough as in the interior, not more than one larva per 1·5 short shoots occurred at the edges on 18th May 1955 and apparently none elsewhere. In July, there was only about one egg to every six short shoots in the interior of the stand, but infestation increased in the spring of 1956, having evidently spread from the edges, where the population had by that time reached the same level as on untreated trees. Reinfestation by *T. laricivorus* after the application of methyl-parathion was more rapid than that by *Coleophora*, being complete by the summer of 1955. It is considered that treatment over a rather larger area would probably give satisfactory control of *Coleophora* for 3–4 years.

In 1955, a further area was selected for treatment with an aerosol containing γ BHC in an attempt to combine control of the moth with that of *T. laricivorus*. Treatment was begun on 21st June, when adults of *Coleophora* were emerging, and numerous dead adults were found after the first half hour, but it was interrupted after two hours on account of wind. It was continued on 23rd June, but could not be completed. Arthropods were collected as before, and, apart from *Coleophora*, they totalled 744 individuals from an area of 7·2 sq. yards in a period of 14–15 hours after treatment.

Bodenstein (G.) & Müller-Bastgen (G.). **Kelthane, ein neues Akarizid.** [Kelthane, a new acaricide.]—*Anz. Schädlingsk.* **30** pt. 12 pp. 207–209, 24 refs. Berlin, 1957.

Kelthane (1,1-di(p-chlorophenyl)-2,2,2-trichloroethanol) is an acaricide that is harmless to insects, including honey bees, and of low toxicity to warm-blooded animals. It is at least equal in toxicity to other well-known materials with which it has been compared, and it is known to be effective against a wide range of mites. Tests were carried out with it against various mites on fruit trees, vines or other plants in Germany, and the results are compared with those obtained in the United States and elsewhere.

Almost complete control of eggs and mobile stages of *Tetranychus telarius* (L.) (*urticae* Koch) was obtained in the laboratory and greenhouse with wettable-powder or emulsion sprays of 0·063 per cent. Kelthane, but only an emulsion spray gave good results at 0·032 per cent. At temperatures under 14–16°C. [57·2–60·8°F.], the full effect of treatment was not obtained until a week after application. Treated plants remained free of infestation for several weeks even though close to untreated, heavily infested ones. Dusts were equally effective. In field tests, good

control of summer eggs and mobile stages of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) on fruit trees was given by sprays of 0·063 per cent. Kelthane, although low temperatures delayed effectiveness, but the winter eggs were apparently unaffected by sprays at the highest concentrations tested, from which it is concluded that spraying during the spring should be carried out just before and during the hatching of the winter eggs. Good control of *Brevipalpus obovatus* Donn. (*inornatus* (Banks)) has been obtained in the United States with three weekly applications of sprays at 0·009 per cent., but one application at 0·032 per cent. did not suffice in Germany against this mite infesting ivy [*Hedera helix*]. Almost complete control of mobile stages and eggs of *Steneotarsonemus* (*Tarsonemus*) *pallidus* (Banks) on strawberry was given by a 0·032 per cent. spray applied about two weeks before bloom, and the surviving mites were killed by a second application during bloom; a concentration of 0·05 per cent. is recommended under field conditions. In laboratory tests, three applications of an emulsion spray of 0·009 per cent. Kelthane were made at weekly intervals on ornamental plants heavily infested by *S. pallidus*; the plants had recovered and were free of infestation after a further four weeks. Control of this mite infesting flower buds of *Cyclamen* was 98 per cent. when the plants were dipped in 0·12 per cent. Kelthane. Good results were given by wettable-powder sprays at 0·032 per cent. against *Phyllocoptes vitis* Nal. on vines.

Observation of phytotoxic effects in the various tests showed that cucumber in the greenhouse was scorched by emulsion sprays at 0·03 per cent., but was not adversely affected by wettable-powder sprays except at concentrations of 0·7 per cent. Hydrangeas in bloom were injured by wettable-powder sprays at a concentration as low as 0·03 per cent., and it is concluded that dusts are generally preferable to emulsions for use on greenhouse plants.

Post (J. J.) & de Jong (D. J.). **De invloed van de temperatuur op het tijdstip van verpoppen en de duur van het popstadium van** *Enarmonia pomonella* **L.** [The influence of temperature on the date of pupation and the duration of the pupal stage in *Cydia pomonella*.]—*Tijdschr. PlZiekt.* **64** pt. 2 pp. 130–141, 1 pl., 7 figs., 4 refs. Wageningen, 1958. (With a summary in English.)

In view of the finding that adult emergence of *Cydia (Enarmonia) pomonella* (L.) on apple in Holland takes place over a long period and is affected by exposure to direct sunlight [*cf. R.A.E.*, A **41** 387], experiments were carried out on the effect of differences in temperature due to artificial irradiation from a 100-watt lamp on the pupation of overwintered larvae in cocoons in pieces of bark and the emergence of adults. The following is based on the author's summary of the results. Preliminary tests showed that pupation began earlier in intensively irradiated bark, in which the temperature reached 24–32°C. [75·2–89·6°F.], than in that less intensively irradiated, in which it was 5°C. [9°F.] lower, 70 and 30 per cent. of the larvae, respectively, having pupated after three weeks. In the test on adult emergence, larvae were exposed to a temperature of 30°C. [86°F.] until all had pupated, and some of the pupae were then irradiated. Emergence began five days earlier, reached the 50 per cent. level 15 days earlier and was completed about three weeks sooner from intensively irradiated pupae than from those not irradiated. The observations explain the prolonged period over which emergence occurs in nature.

Milne (A.), Coggins (R. E.) & Laughlin (R.). **The determination of numbers of leatherjackets in sample turves.**—*J. Anim. Ecol.* **27** no. 1 pp. 125–145, 7 figs., 12 refs. Oxford, 1958.

The following is based partly on the authors' summary. A method of determining the numbers of larvae of the group of *Tipula oleracea* L. (*T. oleracea*, *T. paludosa* Mg. and *T. czizeki* de Jong) in sample turves by means of a hot-water process was devised in northern England in 1955–56 and is described. A foot-square turf with the grass cut close is placed on the fine-meshed wire-gauze bottom of a galvanised metal box that is surrounded by a water-jacket, and the water, the initial level of which is ½ in. above the gauze, is heated electrically to a temperature of 90°C. [194°F.], which is maintained. When the temperature of the soil just below the surface in the middle of the turf reaches 40°C. [104°F.], the level of the water is raised until it just floods the vegetation mat at the surface; heating is then continued for a further 15 minutes. As the temperature in the soil reaches about 30°C. [86°F.], the larvae and pupae move up through the turf and are collected from the surface. The time required for the process ranged from 45–60 minutes for light, fairly dry soil to 120–150 minutes for heavy, sodden, peat-covered clay. Tests showed that from mid-October until the appearance of the first prepupae, usually in June, the hot-water process drives out all the Tipulid larvae inhabiting the turf. Between the first appearance of prepupae and the completion of adult emergence (usually in September), its efficiency drops, but not by more than 5–10 per cent. Where larval populations are high, turf sampling units of 6 × 6 or even 4 × 4 in. are sufficiently large and reduce labour, since four and nine, respectively, can be treated in the apparatus simultaneously.

The hot-water process was used to estimate the efficiency of the St. Ives method of sampling, in which larvae are brought to the surface by means of an irritant emulsion of o-dichlorobenzene poured on the turf in the field after the grass has been cut close [*R.A.E.*, A **20** 541]. The larvae appeared on the surface from 15 seconds to 13 minutes after the application of the fluid and if left alone either re-entered the turf or remained on the surface for up to 20 minutes. Hence observations must be continued for 10–15 minutes after the fluid is applied and the larvae must be counted and removed as they appear; pupae are not affected. The efficiency of the St. Ives method was found to be about 85 per cent. from November to May, after which it fell steeply to almost 0 in July [*cf.* **29** 524]; it did not appear to be influenced by the nature of the soil, but preliminary experiments indicated that doubling the strength or volume of the fluid slightly increased effectiveness. It is concluded that this method is suitable for detecting at least the grosser relative differences in populations between places at any particular time or trends from year to year in any particular place.

Armstrong (M. T.) & Hill (E. G.). **The use of γ-BHC and whitewash mixtures to control infestations of *Ephestia elutella* (Hbn.) in warehouses.**—*J. Sci. Fd Agric.* **10** no. 2 pp. 79–85, 4 refs. London, 1959.

Spraying the walls of warehouses with γ BHC has been suggested in Britain as a supplement to the use of films of pyrethrins in oil on sacks of stored foodstuffs to protect the latter from infestation by *Ephestia elutella* (Hb.). The persistence and effectiveness of γ BHC applied in this way were therefore investigated.

In a preliminary experiment, a warehouse wall that had been limewashed some years before was sprayed with a water-dispersible powder. The theoretical rate of deposit was 37·5 mg. γ BHC per sq. ft., but chemical analysis immediately after application and 1, 2 and 3 weeks later showed mean deposits of 27·8, 10·8, 5·3 and 1·4 mg., respectively, with little difference between wall scrapings and filter paper exposed on the wall. Adults of *E. elutella* that were caged over the deposits overnight for 18 hours did not show maximum mortality until three days later but most of them behaved abnormally immediately after the exposure; there was little difference in mortality between those in contact with the deposit and those exposed to its fumigant effect only, with at least 90, 77 and 40 per cent. mortality of moths exposed 10, 21 and 43 days, respectively, after application. These results indicated that a single treatment would not protect stored products throughout the important period from April to September, when the adult moths are present, and the effect of incorporating the insecticide in a whitewash or distemper, to reduce the rate of loss, was therefore tested; lump lime or hydrated lime could not be used as a wash, as BHC breaks down rapidly in them, and ground whiting was tried.

In the winter of 1953–54, mixtures of 1 cwt. whiting powder, 8 lb. glue size, 22 gal. water and enough of a water-dispersible powder containing 50 per cent. γ BHC to give theoretical deposits of 120 and 146 mg. γ BHC per sq.ft. at the rates of application used were sprayed on warehouse walls, and chemical analysis showed average deposits of 43·9, 19·6, 14·9 and 2·4 mg. per sq. ft. from the first and of 71·3, 57·3, 32·1 and 14·9 from the second, immediately and after 42, 100 and 224 days, respectively. Volatilisation had thus been reduced, and a further test was carried out to ascertain whether the insecticide was still readily available to the insects. The walls of one room were treated in May 1954 with a mixture of 1 cwt. whiting, 11·5 lb. glue size and 2 lb. 50 per cent. γ BHC per 26 gal. spray, to give a theoretical deposit of 146 mg. γ BHC per sq. ft., while those of another were sprayed with whiting and size only. Chemical analysis showed average deposits of 40·1, 21·6, 7·4 and 1·7 mg. γ BHC per sq. ft. in the test room after 1, 29, 72 and 162 days, respectively, and there was 90, 70 and 16 per cent. mortality of *Ephestia* adults caged for 18 hours in contact with the wall after 72, 135 and 162 days, respectively, as compared with less than 8 per cent. in the control series. Sacks of groundnuts and similar commodities in both rooms were sprayed with pyrethrins five times at intervals of 30 days, beginning in early June, but this did not appear to control an established population of *E. elutella*, since 39 larvae per 200 sq. ft. of wall were found on 13th October and 138 on 10th November in the control room, as compared with three and two in the one treated with γ BHC. Adult populations were negligible in the treated room and considerable in others in 1955 and differences were still noticeable in 1956. Adult emergence began in mid-May, and coarsely- or finely-woven bags containing fumigated groundnuts were distributed over the sacks on 9th July 1955, and protected from the pyrethrin sprays, and four larvae, all *E. elutella*, were collected from two coarse bags and none from six fine ones in the treated room and 225, of which 168 were in the coarse bags, from the untreated room between September and January; three of these were *E. elutella*.

In subsequent laboratory tests, a commercial paste distemper containing 0·6 per cent. γ BHC appeared to be more persistent but less insecticidally effective than a powder distemper to which a water-dispersible γ BHC powder was added, probably because the insecticide was less freely available to the moths.

Spraying warehouses in various localities with mixtures of whiting, glue size

and γ BHC to give theoretical deposits of 150 mg. γ BHC per sq. ft. considerably reduced established populations of *E. elutella* and killed other pests, and it is concluded that such treatment at the beginning of moth emergence would cause a marked improvement where routine spraying with pyrethrins is ineffective. A suggested specification for the whiting is cited.

HEUSER (S. G.). **Behaviour of fumigants during vacuum fumigation. IV. Sorption of fumigants by wheat and wheat feed under atmospheric and reduced pressure.**—*J. Sci. Fd Agric.* **10** no. 2 pp. 93–100, 7 graphs, 14 refs. London, 1959.

In this part of a series [*cf. R.A.E.*, A **45** 163, etc.], it is pointed out that as the nominal concentration of a fumigant, calculated from the weight applied and the volume of free space in the fumigation chamber, is seldom attained in practice, owing to sorption of the gas on the surfaces to which it is exposed, a knowledge of the effect of reduced pressure on such sorption is necessary for comparison of the effectiveness of fumigants at reduced and atmospheric pressures [*cf.* **41** 349; **42** 145]. Experiments were therefore carried out to determine the amounts of hydrogen cyanide and methyl bromide sorbed by wheatfeed and of methyl bromide by whole wheat at atmospheric pressure and at a pressure of 5 cm. mercury; both materials were in equilibrium with room conditions of 15°C. [59°F.] and 70 per cent. relative humidity.

Various amounts of fumigant were added to 1-litre flasks containing about 15 g. wheatfeed, and the differences between the weight of fumigant in the free space initially and after periods of 0·5–3 hours were used to determine the amounts sorbed. Comparison of results showed no effect of pressure on rate of sorption of HCN, similar levels of equilibrium being reached towards the end of a three-hour exposure, but rather less methyl bromide was taken up at the reduced pressure, possibly owing to temperature change, as a chemical reaction is involved.

When 10 kg. whole wheat in a cylindrical steel chamber with a capacity of 165 l. was exposed to 8 g. methyl bromide for 24 hours, the fall in concentration in the free space was appreciably greater at the lower than at the higher pressure, owing to a higher initial rate of sorption, which probably resulted from more rapid penetration of the fumigant into the grains; residual bromide in the wheat was correspondingly increased. At atmospheric pressure, continuous stirring resulted in slightly more residual bromide than stirring for the first 15 minutes only. The effect of the reduction of pressure on sorption and residual bromide is considered unimportant in comparison with its effect in improving the distribution of the fumigant throughout the commodity.

METCALF (R. L.). Ed. **Advances in pest control research. Volume III.** —9¼ × 6 in., vii + 448 pp., 33 figs., many refs. New York, N.Y. & London, Interscience Publishers, Inc., 1960. Price £5 9*s*.

The articles in this third volume of a series [*cf. R.A.E.*, A **48** 197, etc.] include **Male sterilization for the control of insects**, by R. C. BUSHLAND (pp. 1–25, 28 refs.), who is concerned mainly with the uses of this method against the screw-worm (*Callitroga hominivorax* (Coq.)), but includes a note on investigations in Hawaii showing that mating with a sterilised male did not reduce the fertility of the eggs laid by a female of *Dacus dorsalis* Hend.,

D. cucurbitae Coq. or *Ceratitis capitata* (Wied.) that had already paired with a normal one and that irradiating the males with the highest dose of γ-rays that did not impair their vigour failed to cause permanent sterility; **Joint action in insecticides**, by P. S. Hewlett (pp. 27–74, 3 graphs, 278 refs.), who reviews the concepts of antagonism and synergism, the synergists that have been developed for pyrethrins and allethrin and for DDT and related compounds, and their chemical structure, synergistic activity and mode of action, and problems in the measurement of responses for joint action, with a note on the control of resistant strains of insects; **The labeled pool technique with particular reference to pesticide research**, by F. P. W. Winteringham (pp. 75–127, 8 figs., 85 refs.), who explains the use of radioactive tracers combined with paper chromatography for studying the effects of insecticides or other toxicants on suitably labelled biological systems, such as insects or plants, in comparison with material not treated with toxicants, the term labelled pool referring to a range of biochemically related metabolites labelled with a suitable radioisotope, and reviews the procedures and techniques involved and the treatment and evaluation of the data obtained; **Recent developments in chemical attractants for insects**, by N. Green, M. Beroza & S. A. Hall (pp. 129–179, 259 refs.), who review the entomological uses of attractants, the types available and their properties, methods of testing attractants, the attractants developed for use against numerous individual insect species, and the relation of attractancy to molecular structure, and state in a note added in proof that recent work has shown that sec.-butyl 4 (or 5)-chloro-2-methyl-cyclohexanecarboxylate, termed medlure, and the corresponding tert.-butyl ester are much more attractive to *C. capitata*, and more persistent, than siglure [**48** 133, etc.], that several compounds related to anisylacetone (otherwise known as 4-(p-methoxyphenyl)-2-butanone), including 4-(p-acetoxyphenyl)-2-butanone, 4-(p-propionoxyphenyl)-2-butanone and 4-(p-hydroxyphenyl)-2-butanone, are superior to it as lures for *D. cucurbitae*, since they attract the sexually immature males, and that 1,2-hexadecanediol and 1,2-epoxyhexadecane attract the males of *Lymantria* (*Porthetria*) *dispar* (L.), though not as strongly as the sex lure emitted by the females [*cf.* **48** 220, etc.]; **DDT-dehydrochlorinase**, by H. Lipke & C. W. Kearns (pp. 253–287, 8 graphs, 58 refs.), who discuss the discovery, inheritance, inhibition by synergists, purification and properties of the enzyme (DDT-dehydrochlorinase) that converts DDT into DDE in DDT-resistant house-flies [*Musca domestica* L.] [*cf.* B **46** 163; **47** 50] and possibly also in other insects, though it has not been definitely demonstrated in these; and **Absorption and translocation of regulators and compounds used to control plant diseases and insects**, by J. W. Mitchell, B. C. Smale & R. L. Metcalf (pp. 359–436, 2 figs., 250 refs.), who described the anatomy of leaves, stems, roots and seeds in relation to the translocation of chemicals, include a section on absorption, translocation, storage and metabolism of insecticides in plants, and note the recent discovery of movement of certain externally applied compounds out of roots into the surrounding soil, which may be of interest for the control of some insects. A cumulative index to the articles in the three volumes so far published is appended.

Düzgüneş (Z.). *Tetranychus tumidellus* **yer-fistiği akarı.** [*T. tumidellus*, the groundnut mite.]—*Plant Prot. Bull.* [N.S.] **1** pt 1 pp. 10–14, 2 figs., 1 ref. Ankara, 1959. (With a summary in English.)

A species of *Tetranychus* found infesting groundnuts at Adana, in southern Turkey, in 1958 was identified by the author as *T. tumidellus*

Pritchard & Baker, although the coloration appeared abnormal. Attempts to breed the mite in the laboratory at Ankara failed.

Öden (T.), Sentürk (I.) & Genç (B.). **Memleketimizde mikrobioassay yolu ile kirazlarda DDT tayini üzerinde bir çalışma.** [An investigation in Turkey on the determination of DDT on cherries by bioassay.] —*Plant Prot. Bull.* [N.S.] **1** pt. 1 pp. 17–19, 1 graph, 2 refs. Ankara, 1959. (With a summary in English.)

In an experiment in Turkey in 1959, cherry trees were sprayed with 3 per cent. wettable DDT against *Rhagoletis cerasi* (L.) on 13th and 25th May, and the residues on the fruits were determined 12 days after the final treatment by bioassay using *Drosophila melanogaster* Mg. They averaged 0·13 part per million on fruits from all parts of the trees and 3·32 p.p.m. on those from the inner parts.

Esin (T.). *Trogoderma granarium* **larvalarına ve** *Tribolium castaneum* **erginlerine karşı malathion em. ile yapılan lâboratuvar denemeleri.** [Laboratory tests of malathion emulsion on larvae of *Trogoderma granarium* and adults of *Tribolium castaneum*.]—*Plant Prot. Bull.* [N.S.] **1** pt. 1 pp. 20–23. Ankara, 1959. (With a summary in English.)

Trogoderma granarium Everts has become an important pest in cereal warehouses in southern Turkey of recent years. As the insecticides used, which included DDT, did not give good control, malathion was tested against the larvae in the laboratory. Residues from 0·1 and 0·2 per cent. emulsion sprays gave complete kill for 3 and about 20 days, respectively, and results against adults of *Tribolium castaneum* (Hbst.) were similar.

Sipahi (R.). **Antep fistıklarında** *Pachypasa otus* **Drury.** [*P. otus* on pistachio.]—*Plant Prot. Bull.* [N.S.] **1** pt. 2 pp. 46–49, 6 figs., 3 refs. Ankara, 1959. (With a summary in English.)

Pachypasa otus (Dru.) all stages of which are described, is an important pest of pistachio (*Pistacia vera*) in the Gaziantep area of Turkey. The eggs of this Lasiocampid are laid on the trunks, and the larvae hatch in September, overwinter in holes and under stones and feed on the leaves and shoots, giving rise to adults at the end of August [*cf. R.A.E.*, A **46** 238]. There is only one generation a year.

Fullmer (O. H.), Kurtz (E. A.) & Cassil (C. C.). **A new material for the control of the pear leaf blister mite.**—*J. econ. Ent.* **52** no. 2 pp. 183–185, 2 figs., 6 refs. Menasha, Wis., 1959.

Sulphur has long been used against *Eriophyes pyri* (Pgst.) on pear and has controlled blistering on the leaves and fruits, but not damage within the buds, possibly because this is caused by a different form of the mite [*cf. R.A.E.*, A **39** 144, etc.]. Phostex (a mixture of bis(dialkyloxyphosphinothioyl) disulphides), which has a low mammalian toxicity (its acute oral LD50 for white rats being 2·5 g. per kg.) proved to be extremely toxic to the mites on leaves and fruit and in the buds in California in 1955–57.

In 1955–56, treatment after harvest, in September, with an emulsion concentrate containing 8 lb. Phostex per U.S. gal. applied at the rate of 1 pint per 100 gal. spray gave practically complete control of mites in the buds for 125 days and was as effective as a lime-sulphur spray in preventing blistering of the fruits and leaves. In 1956–57, when the autumn spray of Phostex was followed by a second application at the delayed-dormant stage, the mite was virtually eliminated, and neither this treatment nor spraying after harvest with the Phostex emulsion and at the dormant stage with Phostex in oil emulsion, which was also effective against the mites, injured the trees. The post-harvest sprays also controlled *Panonychus ulmi* (Koch), *Tetranychus telarius* (L.) and *Psylla pyricola* Först., and Phostex dissolved in dormant oil gave excellent control of various Coccids and aphids.

Bibby (F. F.) & Tuttle (D. M.). **Notes on phytophagous and predatory mites of Arizona.**—*J. econ. Ent.* **52** no. 2 pp. 186–190, 4 refs. Menasha, Wis., 1959.

Records are given of 38 phytophagous and 13 predacious mites taken in Arizona, mostly of recent years, showing the dates, localities and plants concerned, with notes on the order of frequency of the commonest plant-feeding species.

Ebeling (W.) & Wagner (R. E.). **Rapid desiccation of drywood termites with inert sorptive dusts and other substances.**—*J. econ. Ent.* **52** no. 2 pp. 190–207, 5 figs., 41 refs. Menasha, Wis., 1959.

The following is based largely on the authors' abstract. Efforts to control insects by means of desiccating dusts have been made primarily with abrasive materials, but *Kalotermes minor* Hagen was found to be more susceptible to sorptive than to abrasive dusts. By means of a staining technique, it was shown that sorptive dusts remove the lipoid protective layer covering the epicuticle, causing the termites to lose water rapidly. The insects needed only to crawl on a thin film of the dust, and they died after losing about 30 per cent. of their body weight in water; certain silica aerogels were particularly effective against these and many other insects [*cf. R.A.E.*, A **47** 379]. Although conventional insecticides sometimes caused more rapid knockdown, they did not kill the insects as rapidly as did the more effective desiccating dusts.

Certain water-soluble fluorides, incorporated into the silica aerogels in the process of manufacture, greatly increased their effectiveness, even at low relative humidities, but the advantage obtained from them increased with increasing relative humidity, so that the versatility of the dusts was increased. The presence of fluorides as monomolecular layers in the porous aerogel particles did not decrease the ability of these to adsorb wax. After the wax is adsorbed or disrupted, the fluorides act as contact insecticides. In addition, the strong positive charge that they impart to the particles greatly increases the ability of the latter to adhere to the dusted surface.

Various other materials, including oil [*cf.* **31** 69], draw water from the insect's body, and termites that were immersed in oil to which a surface-active solute had been added, lost water more rapidly than those dipped in oil alone. Desiccation was greatly enhanced when the oil was later removed and the insect cuticle exposed directly to the air, death sometimes resulting more rapidly than when the insects were continuously

immersed in oil. Desiccation of the termites was caused experimentally by treatment with parathion, sodium fluoride and anhydrous magnesium perchlorate; when the treated insects or those shaken in a sorptive dust were immersed in oil, water droplets appeared on the body surface.

Wagner (R. E.) & Ebeling (W.). **Lethality of inert dust materials to *Kalotermes minor* Hagen and their role as preventives in structural pest control.**—*J. econ. Ent.* **52** no. 2 pp. 208–212, 1 fig. Menasha, Wis., 1959.

The following is based on the authors' abstract. Tests are described in which groups of ten late-instar nymphs of *Kalotermes minor* Hagen were maintained at temperatures of 60–80°F. and 60–100 per cent. relative humidity in 100-ml. beakers each containing 1 cc. of one of 162 insecticide diluents and other finely divided inert materials. The experiments were repeated with blocks of wood, dusted at an air velocity of 1,400 ft. per minute in a specially constructed wind tunnel, which is described, using the materials that had given complete mortality in five hours or less in the first test. The results showed that of the four outstanding groups of materials, silica gels, aerogels or precipitates were more and diatomites less effective than montmorillonite clays and attapulgite clays.

In tests of dust distribution in the attics of houses, blocks of wood were exposed at points representing different distances and degrees of accessibility from the point of discharge of the dust. After treatment, the blocks were taken to the laboratory and termites caged with them. The results showed the importance of the bulk density of the dusts. The lighter materials became more uniformly distributed throughout the attic, and their superiority to the heavier materials increased with increasing distance from the point of discharge.

Secrest (J. P.) & Thornton (D. G.). **A comparison of the toxicity of various insecticides to the spruce budworm.**—*J. econ. Ent.* **52** no. 2 pp. 212–214, 1 fig., 6 refs. Menasha, Wis., 1959.

In laboratory tests in Maine, twigs of balsam fir [*Abies balsamea*] from the forest were sprayed with 12 per cent. DDT in oil solution, 4 per cent. γ BHC in either fuel oil or xylene emulsion, the latter with Aroclor 5460 [a chlorinated polyphenyl], 3·16 per cent. aldrin in fuel oil, 1·8 per cent. dieldrin in a mixture of xylene and fuel oil or 1·4 per cent. endrin emulsion, one day after being infested with larvae of *Choristoneura fumiferana* (Clem.). The sprays were applied in droplets of about 120μ mass median diameter at a rate corresponding to 1 U.S. gal. per acre, and mortality counts made seven days later showed that DDT gave the best results, being significantly superior to all the other materials except BHC; the latter was not improved by the addition of Aroclor. When the concentrations were reduced by 75 per cent., DDT still gave 93 per cent. kill and was significantly better than BHC. Sixth-instar larvae were more resistant to the insecticides than younger ones.

In a test in which the sprays were applied to uninjured shoots and allowed to weather out of doors for 3, 7 or 14 days before the twigs were brought in and infested, DDT was again better than any other insecticide, all differences but some of those between three-day old deposits of DDT and BHC being significant.

Harcourt (D. G.) & Cass (L. M.). **Control of caterpillars on cabbage in the Ottawa Valley of Ontario and Quebec, 1956–1957.**—*J. econ. Ent.* **52** no. 2 pp. 221–223, 1 graph, 7 refs. Menasha, Wis., 1959.

In the Ottawa Valley of Ontario and Quebec, the late crop of cabbage, which is planted out in late June and matures in October, is attacked by *Pieris rapae* (L.), *Plutella maculipennis* (Curt.) and *Trichoplusia ni* (Hb.), of which the first is the most important and causes considerable damage each year [*cf. R.A.E.*, A **45** 228]. DDT gave good control in 1947–54 [*cf.* **45** 256–257], but failed to cause significant reductions of *T. ni* in 1955 [*cf.* **46** 192], and various insecticides were therefore compared with it in 1956 and 1957. Four applications of 25–40 lb. dust or 100 gal. emulsion spray per acre were made at 15-day intervals from 20th–23rd July, in the early morning, when wind velocities were low, and 0·75 lb. Phosdrin per acre in emulsion concentrate and 0·25 lb. endrin, 0·75 lb. Guthion, 0·33 lb. parathion or rotenone, 1 lb. DDT or malathion, and 1·5 lb. toxaphene per acre in dusts gave 87–97 per cent. control of *Plutella* and *Pieris* in 1956, when populations of *T. ni* were negligible. The first three materials gave 85–92 per cent. control of *Plutella*, *Pieris* and a strain of *T. ni* resistant to DDT in 1957, but the others were ineffective against *T. ni*. Comparison of these with earlier results did not suggest the development of strains of *Pieris* resistant to DDT.

Laudani (H.), Gillenwater (H. B.), Kantack (B. H.) & Phillips (M. F.). **Protection of *Citrus* pulp against insect infestation with surface applications of pyrethrum-piperonyl butoxide wettable powder.**—*J. econ. Ent.* **52** no. 2 pp. 224–227, 1 fig., 5 refs. Menasha, Wis., 1959.

Dried *Citrus* pulp is susceptible to infestation by many insects, notably *Oryzaephilus surinamensis* (L.), *Lasioderma sericorne* (F.), *Plodia interpunctella* (Hb.), *Ephestia cautella* (Wlk.), *Anagasta kühniella* (Zell.) *Tribolium* spp., *Cryptolestes pusillus* (Schönh.) (*Lacmophloeus minutus* (Ol.)) and *Sitotroga cerealella* (Ol.). Since it is used as food for animals, it must not contain harmful insecticide residues, and the materials and methods of application that are appropriate are limited. Weekly applications of synergised pyrethrum aerosols proved expensive and not very effective over a period of three years, and laboratory tests showed that heavier, more persistent and more toxic surface residues of this insecticide were given by wettable-powder sprays than by other formulations [*cf. R.A.E.*, A **46** 352].

In tests made under commercial conditions in 1957, equal total quantities of a mixture of pyrethrum and piperonyl butoxide (1:10) were applied to stacks of infested bagged pulp, weekly in aerosols or monthly in wettable-powder sprays applied to the surface of the stacks. Chemical analysis for piperonyl butoxide showed that than more ten times as much residue was obtained from the wettable powder as from the aerosol; some of the insecticide from both formulations penetrated the burlap bags and entered the pulp, but the amount was small in comparison with the quantity on the surface. Stacks that were sprayed only once in three months lost less than 20 per cent. of the initial residue in the interval, indicating a high rate of persistence of the powder. Spraying was much more effective than aerosol treatment in reducing the insect population in the pulp, and no living insects were found after four months in samples from stacks that had received two monthly sprays of 10 mg. pyrethrum and 100 mg. piperonyl butoxide per sq. ft. and were covered with vinyl tarpaulins after the second and immediately sprayed again.

It is concluded that monthly applications of 5 mg. pyrethrum with 50 mg. piperonyl butoxide per sq. ft. in wettable-powder sprays will protect large quantities of stored *Citrus* pulp from infestation and give better results and cost less than aerosol treatment.

Dean (H. A.). **Seasonal distribution of mites on Texas grapefruit.**—*J. econ. Ent.* **52** no. 2 pp. 228–232, 18 refs. Menasha, Wis., 1959.

Little is known of the seasonal occurrence of mites on *Citrus* in the Lower Rio Grande Valley of Texas, and investigations on the population trends of the various species on grapefruit leaves and the factors that influence changes in population were carried out there in 1954–57, in order to provide a basis for control. The results showed that eggs and larvae of *Eutetranychus banksi* (McG.) were present in every month of the year, with the lowest populations in February–April and the highest in May–July. Numbers increased when rainfall and relative humidity were low and average temperatures were over 80° F. for 8–10 hours a day, and were reduced by heavy rainfall. Populations of *Phyllocoptruta oleivora* (Ashm.) varied less regularly, but high relative humidity and low wind velocity appeared to be favourable and low relative humidity and high wind velocity unfavourable; numbers generally increased after periods of heavy rain, and rather high populations developed in winter. *Brevipalpus* spp. and Tydeids were most numerous in the second half of the year and in a dry season.

Populations of *Typhlodromus* spp. increased during May and were usually greatest in summer and autumn. Other predacious mites included *Allothrombium* sp. and *Balaustium* sp., which fed on *E. banksi* and *P. oleivora*, respectively.

Wallis (R. L.) & Carter (R. H.). **Methoxychlor residues on vegetable crops.**—*J. econ. Ent.* **52** no. 2 pp. 232–233. Menasha, Wis., 1959.

Since some vegetable crops, such as okra [*Hibiscus esculentus*], summer squash, tomatos and strawberries, must be picked several times a week, methoxy-DDT (methoxychlor) cannot be fully utilised for their protection against insects unless it can be applied up to one day before harvest without leaving harmful residues. Experiments were therefore carried out in Maryland in 1955–57 in which the insecticide was applied in small field plots at 1·75 lb. per acre in dusts or wettable-powder or emulsion sprays and at 3–3·5 lb. per acre in wettable-powder sprays. Residue determinations at intervals after treatment indicated that at the existing tolerance of 14 parts per million, methoxy-DDT can safely be applied one day before the harvesting of summer or winter squash, cantaloupes, eggplant [*Solanum melongena*], pumpkin, bell peppers [*Capsicum*], tomatos, kohlrabi, turnip roots and strawberries. The necessary intervals of not more than one and three days between the last application and harvesting of okra and green onions, respectively, would entail tolerances of 20 and 40 p.p.m., respectively.

Marzke (F. O.) & Dicke (R. J.). **Laboratory evaluation of various residual sprays for the control of Dermestids infesting milk-drying plants.**—*J. econ. Ent.* **52** no. 2 pp. 234–236. Menasha, Wis., 1959.

Contamination of dried milk by *Trogoderma inclusum* Lec. and *Attagenus laevigatus* (F.) (*piceus* (Ol.)) has become a problem in the United

States in recent years, and as proper sanitation and the use of deposit sprays appear to be the most promising methods of control, numerous compounds were tested for toxicity to the larvae, which were caged for 6–7 days on panels bearing deposits from acetone solutions.

In preliminary tests with *T. inclusum*, confined on the deposits after one hour, 50 mg. lindane [almost pure γ BHC], extended with 50 mg. Aroclor 5460 (a chlorinated polyphenyl), 50 mg. malathion, alone or as Mercaphos (3 per cent. malathion in a neutral water emulsion), and 50 mg. diazinon or Chlorthion per sq. ft. gave complete mortality, whereas two other phosphorus compounds, aldrin, γ BHC alone and 10 mg. pyrethrins with 100 mg. piperonyl butoxide killed some 60 per cent. and the other materials were still less effective. Larvae of *A. laevigatus* exposed to 50 mg. γ BHC, diazinon or malathion per sq. ft. were all moribund or dead in 6–7 days. In tests in which the deposit was allowed to age for periods of 2–22 weeks before the insects were confined on them, 100 mg. malathion per sq. ft. retained high toxicity to *T. inclusum* for at least three months and to *A. laevigatus* for five months, and the addition of 10 mg. piperonyl butoxide increased the period of residual toxicity. At 50 mg. per sq. ft. diazinon appeared to remain effective against both species and Chlorthion against *Trogoderma* for one month; γ BHC was moderately effective for 7–8 weeks at 200 mg. per sq. ft., but permitted insect survival on all panels at 50 mg., with or without the addition of Aroclor, and aldrin and dieldrin were ineffective.

It is concluded that malathion, Chlorthion, diazinon and γ BHC, in descending order, are the most promising materials for the control of these Dermestids.

Marzke (F. O.) & Dicke (R. J.). **Laboratory evaluations of various residual sprays for the control of cheese mites.**—*J. econ. Ent.* **52** no. 2 pp. 237–240. Menasha, Wis., 1959.

Various species of mites infest cheese and may damage it, but *Tyroglyphus farinae* (Deg.) (*Acarus siro*, auct.) and *Tyrophagus* spp. were usually the most abundant in warehouses inspected in the United States. Numerous chemicals were tested as deposit sprays against *Tyroglyphus* at 35, 45 and 55°F. by methods described [*cf.* preceding abstract], and lindane [almost pure γ BHC] proved the most effective at all temperatures, giving complete or practically complete mortality in three days after aging for about four weeks at rates of 50 or 200 mg. per sq. foot. It was followed in order by diazinon and Hercules AC 426-A (5-dichloromethyl-1,2,3,4,7,7-hexachloro-bicyclo[2.2.1]-hept-2-ene) at 35°, by diazinon, AC 426-A, dieldrin, aldrin, and a mixture of 10 mg. pyrethrins and 100 mg. piperonyl butoxide at 45° and by diazinon and Strobane at 55°, all of which gave good results, at least at the higher rate. Other materials were much inferior. Most of the toxicants appeared to be least effective at 35° and most effective at 45°, but the lower temperature tended to delay the loss of toxicity. *Tyrophagus* appeared to be less susceptible than *Tyroglyphus* to the toxicants, particularly to synergised pyrethrins, but at 55° γ BHC still gave good control after aging for five weeks.

Weaver (C. R.). **Egg development in the meadow spittlebug and Hopkins' bioclimatic law.**—*J. econ. Ent.* **52** no. 2 pp. 240–242, 5 refs. Menasha, Wis., 1959.

Examination of 309 samples each comprising ten females of *Philaenus leucophthalmus* (L.), collected in some 30 localities in the north-eastern

United States in August–September in various years, showed that the occurrence of eggs within the body did not conform to the expectation based on Hopkins' bioclimatic law [*cf. R.A.E.*, A **8** 87]. An equation is computed from the data obtained by which the number of eggs at a given time in a given locality can be predicted, and the dates for the proper application of insecticides against *Philaenus* in autumn in Ohio were confirmed [*cf.* **40** 230].

Carlson (E. C.). **The effect of *Lygus* and hyaline grass bugs on lettuce seed production.**—*J. econ. Ent.* **52** no. 2 pp. 242–244, 4 refs. Menasha, Wis., 1959.

The following is based largely on the author's abstract. Damage to the lettuce seed crop in the Sacramento Valley of California was attributed by growers to *Lygus hesperus* Knight, but field-cage experiments carried out in 1956 showed that infestations of 1–4 adult females of this Mirid per plant caused no significant decrease in seed yield or germination, no reduction in the weight or size of the seeds and no increase in the numbers of abnormal seedlings; the bugs fed little and no nymphs appeared in the cages. Bugs that became numerous after mid-August in lettuce fields containing maturing seed crops were later identified as *Liorhyssus hyalinus* (F.), but they appeared to be associated mainly with aphids. Investigations by K. B. McKinney in Arizona in 1938–42 showed that this Coreid feeds on lettuce seed, but that only populations of 400 or more per plant seriously reduce the yield, though populations of 35–50 adults and some nymphs per seed plant may cause economic damage, especially by reducing viability. In the Sacramento Valley, seeds maturing early were not damaged in an average season, but those maturing later were severely damaged or destroyed. DDT and toxaphene are believed to give control of heavy infestations of late-maturing seed crops.

Stone (M. W.) & Foley (F. B.). **Effect of time of application of DDT on *Lygus* bug populations and yield of lima beans.**—*J. econ. Ent.* **52** no. 2 pp. 244–247, 4 refs. Menasha, Wis., 1959.

Lima beans in southern California are damaged by species of *Lygus*, mainly *L. hesperus* Knight, but also *L. elisus* Van D. The amount of injury varies from year to year, so that it is difficult to decide whether control measures will be necessary, but it may occur during most of the growing season. Experiments on the timing of DDT applications were carried out at several places in 1952–57. A dust containing 5 per cent. DDT and 50 per cent. sulphur was applied at 30 lb. per acre in 1952–54, and an emulsion spray of 1·5 lb. DDT in 12–16 U.S. gal. per acre in 1955–57. The experimental areas were sprayed with 1 lb. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] per acre at the beginning of the season to discourage increases of *Tetranychus telarius* (L.), and this treatment had no effect on *Lygus*. The beans were sown in May and treated with DDT in July–August. An early application, at blossom time, and an intermediate one, when small pods were present, were equally effective, increasing the yield by about 200–250 lb. per acre, and better than a later one, made when the pods were 1·5–2 in. long. Beans from all treated plants showed less pitting by *Lygus* than those from untreated ones; a single intermediate application or one early and one late one apparently resulted in least pitting, but the second of these applications did not reduce damage enough to be economically justified and did not increase the yield.

In untreated plots, the population reached a maximum in early August, showing that treatment in the second half of July was necessary to prevent damage to small and half-mature pods on the plants in August. An application at this time also helped to reduce damage to the pods by *Heliothis zea* (Boddie), which was found to be more extensive than had been suspected.

Schlinger (E. I.), van den Bosch (R.) & Dietrick (E. J.). **Biological notes on the predaceous earwig *Labidura riparia* (Pallas), a recent immigrant to California (Dermaptera: Labiduridae).**—*J. econ. Ent.* **52** no. 2 pp. 247–249, 7 refs. Menasha, Wis., 1959.

An earwig found in relative abundance in or near lucerne fields during investigations on *Therioaphis maculata* (Buckt.) in the Imperial Valley of California in 1955–57 was identified as *Labidura riparia* (Pall.) which is cosmopolitan in distribution and also occurs in other parts of the southern United States. In California it appears to be confined to the agricultural areas of the Bard, Imperial and Palo Verde valleys, mainly in lucerne fields, and particularly in those that have well-defined ridges between the beds; these are apparently preferred because they have a humid microclimate but are not flooded at irrigation time.

Observations on colonies maintained at 75°F. and 50 per cent. relative humidity in the laboratory between November 1957 and April 1958 showed that the earwig constructed rather extensive and elaborate tunnels in the soil. The eggs were deposited in groups of 20–50 and hatched in about 14 days, and the adults lived for at least five months and brooded over the eggs. There were two distinct forms of males, of which only the smaller was observed to mate. Flying was not observed and may be impossible, as the wings are flimsy and weak, and this may explain why *L. riparia* has not crossed the desert to become more widespread in California. The earwig fed ravenously on almost all types of living insects offered to it; it appeared to feed principally on insects inhabiting soil or débris, such as Lepidopterous larvae and pupae, but was observed in the laboratory to climb lucerne stems and consume large populations of *T. maculata* and *Macrosiphum pisum* (Harris) on them; this was not observed during the day in the field, but may occur on warm nights. When deprived of living insects, *L. riparia* fed on lucerne seeds, on which it did not survive for long, or on newly dead insects; all the earwigs died within ten days when deprived of water.

Nickel (J. L.) & Sylvester (E. S.). **Influence of feeding time, stylet penetration, and developmental instar on the toxic effect of the spotted alfalfa aphid.**—*J. econ. Ent.* **52** no. 2 pp. 249–254, 3 figs., 14 refs. Menasha, Wis., 1959.

Greenhouse investigations on the production of symptoms of yellow vein-banding on seedling lucerne by *Therioaphis maculata* (Buckt.) were carried out in California in the spring and summer of 1958 [*cf. R.A.E.*, A **47** 16, etc.]. When single nymphs in the third or fourth instar were caged on seedlings for 23, 100 or 1,000 minutes, 5, 10 and 77·5 per cent., respectively, of the plants showed toxic symptoms within four days, and it was calculated that 50 per cent. incidence of disease would occur after about ten hours of feeding by one insect per plant. No symptoms occurred on uninfested seedlings. Feeding by nymphs in these two instars had a greater toxic effect than feeding by those in the first or second instar.

The plants varied considerably in the expression of toxic symptoms, and field tests showed that most of the variation was due to varying plant susceptibility and not to inherent differences between individual aphids or clones.

When allowed to feed through plastic membranes over water, adult apterae of both *T. maculata* and *Myzus persicae* (Sulz.) formed salivary sheaths, which were quite distinct for each species in size and configuration, and in experiments in which nymphs of *T. maculata* were allowed to feed continuously for one or five hours on lucerne plants and others were interrupted periodically, to ensure at least five insertions of the stylets and therefore the formation of at least five salivary sheaths, the proportion of plants showing symptoms increased with the length of the feeding time, but not, apparently, with increases in the number of sheaths produced. Attempts to develop a satisfactory test for the presence of the toxic principle proved unsuccessful.

Williams (R. E.) & Neiswander (R. B.). **Investigations on control of the bronze birch borer and the flatheaded apple tree borer.**—*J. econ. Ent.* **52** no. 2 pp. 255–257, 4 refs. Menasha, Wis., 1959.

Agrilus anxius Gory is a severe pest of birch (*Betula*), particularly paper birch (*B. papyrifera*), in Ohio, and *Chrysobothris femorata* (Ol.) attacks many species of shade trees grown in the State, being primarily a pest of newly transplanted or weak trees.

The eggs of *A. anxius* are laid in bark cracks in the crown of the tree, between mid-June and mid-July, and hatch in 10–11 days. The larvae burrow in the cambium, sometimes girdling the tree, and in north-eastern Ohio transform to adults between late May and early July of the next year. As the top of a tree dies, the insects attack successively lower branches, and they usually kill the whole tree in 3–5 years. Sprays were tested against the two Buprestids in 1956–57, and the amounts of insecticide given are those used per 100 U.S. gal. Applications were begun about the end of May, when the adults were emerging. Against *A. anxius*, *B. papyrifera* and *B. alba* were sprayed in 1956 with a 25 per cent. DDT emulsion concentrate once at 2 U.S. gal. or 2–3 times at intervals of 20 days at 1 U.S. gal., or with a 25 per cent. parathion emulsion concentrate twice at 0·5 U.S. gal. The same DDT treatments and two applications of 6·67 lb. 15 per cent. wettable parathion, at an interval of about 30 days, one of 2 U.S. gal. 57 per cent. malathion emulsion concentrate with 1·5 U.S. gal. 25 per cent. DDT emulsion concentrate and one of 5 lb. 50 per cent. wettable DDT with 5 U.S. gal. polyethylene, to prolong effectiveness and seal cracks, were made in 1957. All treatments reduced subsequent borer populations; the parathion and malathion treatments were apparently the most effective and there was no evidence that 2–3 applications of DDT were more effective than one.

Against *C. femorata* several materials were tested on various species of trees. Infestations were low and the results uncertain in 1956, but in 1957, two applications of 6·7 lb. 15 per cent. wettable parathion to the trunk and larger branches gave the best results; DDT gave good control when applied at 5 lb. 50 per cent. wettable powder or 3 U.S. gal. 25 per cent. emulsion concentrate, both with 5 U.S. gal. polyethylene, but showed variable results alone, and phorate (Thimet) was relatively ineffective. As *C. femorata* sometimes breeds in wind-blown trees, insecticides were applied to small, freshly cut apple boles in cans on 14th June 1956. Treatment with 4 U.S. gal. 25 per cent. DDT emulsion concentrate, alone or

with 32 U.S. gal. latex, and with 0·5 U.S. gal. 25 per cent. parathion emulsion concentrate reduced the number of larvae subsequently found in four boles from 14 to 2, 0 and 2, respectively.

It is concluded that parathion is consistently effective against both borers and that one application of a relatively concentrated spray of DDT with a liquid latex or polyethylene to the trunks of newly transplanted trees may be adequate for protection against *C. femorata*.

Weigel (C. A.), Sullivan (W. N.), Hornstein (I.) & Thomas (C. A.). **Tests on lindane and aldrin vapors in the control of adult mushroom flies.**—*J. econ. Ent.* **52** no. 2 pp. 257–258, 3 refs. Menasha, Wis., 1959.

Details are given of experiments carried out in the United States in 1951 to test the effect of the vapour dispersed by passing an air stream through a filter previously treated with an insecticide on adult mushroom flies, chiefly *Sciara* (*Bradysia*) *fenestralis* Zett. and *Megaselia agarici* (Lintn.), in mushroom houses. An acetone solution of lindane [γ BHC] or aldrin was sprayed on both sides of a Fiberglas air-conditioning filter, which was fixed to the guard of an electric fan; the acetone evaporated, leaving a coating of crystals, which provided a lasting source of insecticide vapour. It was found that treatment for some 3–4 hours a day killed the adult flies without leaving excess residues or adversely affecting the flavour or aroma of the mushrooms. It should be repeated for at least four consecutive days, to control the large numbers of adults that emerge daily from the compost and mushrooms.

Adlerz (W. C.). **Factors affecting transmission of bean yellow mosaic virus.**—*J. econ. Ent.* **52** no. 2 pp. 260–262, 19 refs. Menasha, Wis., 1959.

The bean yellow mosaic virus infects numerous leguminous plants [*cf. R.A.E.*, A **43** 427; **47** 482], and tests to compare some of these as sources of virus for transmission by aphids and for relative susceptibility to inoculation with the virus by aphids are described. *Myzus persicae* (Sulz.), reared on broccoli, and *Macrosiphum pisum* (Harris), reared on broad bean (*Vicia faba*), were starved for 30 minutes or more and transferred individually to infected plants. Most fed for 10–30 seconds, the minimum time necessary for acquiring the virus being 6–10 seconds, and they were then transferred singly to healthy plants, on which they were left for an hour or more.

Different source plants caused significant differences in transmission by both species, broad bean being consistently better than alsike clover (*Trifolium hybridum*), Alaska pea (*Pisum sativum*) and a dwarf variety of bean (*Phaseolus vulgaris*), but there were no differences between species in susceptibility to inoculation with the virus. Five horticultural varieties of *P. vulgaris* showed differences in susceptibility to inoculation, relative susceptibility varying with the species of aphid used and the environmental conditions under which the plants were grown.

Gatterdam (P. E.), Casida (J. E.) & Stoutamire (D. W.). **Relation of structure to stability, antiesterase activity and toxicity with substituted-vinyl phosphate insecticides.**—*J. econ. Ent.* **52** no. 2 pp. 270–276, 1 fig., 26 refs. Menasha, Wis., 1959.

The following is based on the authors' abstract. Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate], OS-1808 [diethyl 2-ethoxy-

carbonyl-1-methylvinyl phosphate], OS-1836 (diethyl 2-chlorovinyl phosphate) and many related substituted-vinyl phosphates were found to be mixtures of geometric isomers that could be separated by partition chromatography with silica-gel columns. The isomer first eluted (termed the α isomer) was the major component. It was more toxic to rats and adults of *Musca domestica* L., more potent in inhibiting blood cholinesterase, more rapidly attacked by permanganate and less stable in alkali and in plants than the second (β) isomer [*cf. R.A.E.*, A **47** 116]. The configuration of the isomers is unknown, and a third (γ), of low toxicity, was found in OS-1836.

Irradiation of either the α or β isomer of OS-1808 with ultraviolet light resulted in a mixture of α and β isomers (3:7); the presence of 10 parts β to 1 part α isomer had no effect on the toxicity of the latter to *M. domestica*. Dimethyl 2-methoxycarbonyl-2-chloro-1-methylvinyl phosphate was found as an impurity in technical Phosdrin; it proved only half as toxic as the pure compound to rats and *Macrosiphum pisum* (Harris) and still less so to *Musca domestica*. Hydroxyproline and certain pyridine aldoxime methiodides were the most active of 55 amino acids and related chemicals tested as catalysts for the hydrolysis of α Phosdrin. Comparison of the α fractions from 23 substituted-vinyl phosphates showed no distinct correlation between alkaline stability, toxicity to rats and *M. domestica* and anticholinesterase activity. Many of the substituents about the vinyl grouping resulted in compounds of quite high insecticidal activity.

Chada (H. L.). **Insectary technique for testing the resistance of small grains to the greenbug.**—*J. econ. Ent.* **52** no. 2 pp. 276–279, 3 figs., 1 ref. Menasha, Wis., 1959.

The following is based on the author's abstract. *Toxoptera graminum* (Rond.) is a pest of small grains in the central and south-western United States and causes serious damage in outbreak years. As the use of insecticides against it is limited by cost, and natural enemies and cultural control are often ineffective, the development of resistant cereal varieties is desirable [*cf. R.A.E.*, A **48** 32, etc.], and an insectary technique for the rapid testing of resistance was developed. Test varieties, grown in trays covered with plastic cages, are subjected to uniform infestation for 10–14 days in an environment controlled to give an average temperature of 75°F. and artificial daylight for 16 hours a day throughout the year, and rated according to the leaf area damaged on each plant; relative humidity is not controlled as it remains at the satisfactory level of 50–60 per cent. As all variable factors that might affect aphid development and plant growth are controlled, any differences in the reaction of the plants to infestation are probably due to their inherent characteristics.

Barnes (M. M.) & Ortega (J. C.). **Experiments with protein hydrolysate bait sprays for control of the walnut husk fly.**—*J. econ. Ent.* **52** no. 2 pp. 279–285, 7 graphs, 5 refs. Menasha, Wis., 1959.

Tests of poison bait-sprays for the control of *Rhagoletis suavis completa* Cress. on walnut in California, carried out in 1955–57, showed that a controlled maize-protein hydrolysate attracted more adults than an acid hydrolysate of maize-protein, partly hydrolysed yeast protein, an enzymatic hydrolysate of yeast protein, soy-bean protein hydrolysate or glycine, and that wettable malathion was more toxic to them than technical trichlorphon (Dipterex).

In orchard tests in 1956, good control of infestation was given by high-volume full-coverage sprays of wettable malathion alone and by bait-sprays of malathion with a maize-protein hydrolysate, applied in low volume by aircraft or higher volume by ground equipment, and in 1957, when malathion was applied in a full-coverage spray at 8–9 lb. 25 per cent. wettable powder in 600–700 U.S. gal. per acre without attractant or in a bait-spray at 4 lb. 25 per cent. wettable powder in 100 U.S. gal. per acre from the ground or 10 U.S. gal. from an aeroplane, both with and without attractant, in July–August, counts of adults caught in bait-pails containing glycine and sodium hydroxide [*cf. R.A.E.*, A **47** 431] showed that the bait-sprays, with and without the protein hydrolysate, and the full-coverage spray depressed adult populations for 12, 5–7 and 9–11 days, respectively. Very good protection of the nuts from infestation resulted from either the bait- or the full-coverage spray, applied twice at an interval of 25 days; although fly populations increased during the second half of the interval, there was little oviposition.

The malathion bait-sprays resulted in high populations of *Tetranychus cinnabarinus* (Boisd.) on the Placentia and Payne varieties of walnut during the second year, but not on blocks of Eureka walnuts, which are very susceptible to *Rhagoletis*, but less so than the other varieties to the mite.

Chamberlain (W. F.). **The behavior of agricultural insects toward olfactory repellents in the olfactometer and in split-arena tests.**—*J. econ. Ent.* **52** no. 2 pp. 286–289, 5 refs. Menasha, Wis., 1959.

In further tests in South Carolina of the repellency of chemical compounds to insects of agricultural importance [*cf. R.A.E.*, A **48** 223], honey bees, *Lygus lineolaris* (P. de B.), *Spissistilus festinus* (Say), *Hypera nigrirostris* (F.) and *H. meles* (F.), collected in the field, were exposed in an olfactometer, and camphor, camphene, p-dichlorobenzene, acetophenone and sassafras oil appeared to be the most repellent of the materials tested, though some others, such as cyclohexylcyclohexanol, might have proved as effective if used at equally high concentrations. In general, the five species of insects did not behave differently towards the repellents, and differences in temperature had little effect on the results. Split-arena tests with *L. lineolaris*, *H. meles* and *Macrosiphum pisum* (Harris), in which the insects were confined in cages made by stretching cheesecloth over 6-in. embroidery hoops and exposed over treated and untreated surfaces, revealed very little, if any, repellency in camphene, camphor or acetophenone, probably owing to the unsatisfactory aerial boundary between the treated and untreated halves. A similar condition probably existed in the field tests previously reported [*loc. cit.*]. The materials tested were all olfactory repellents, and gustatory repellents might prove more effective.

Lichtenstein (E. P.) & Polivka (J. B.). **Persistence of some chlorinated hydrocarbon insecticides in turf soils.**—*J. econ. Ent.* **52** no. 2 pp. 289–293, 15 refs. Menasha, Wis., 1959.

Plots of turf in Ohio were dressed with 1–25 lb. chlordane or 0·25–10 lb. γ BHC per acre in 1946, 1–20 lb. heptachlor in 1949 or 3–75 lb. aldrin in 1954 for the control of insects and left undisturbed until 1957 or 1958, when soil samples were collected from the top three inches of soil. Specific chemical analyses and bioassay with *Drosophila melanogaster* Mg. [*R.A.E.*, A **46** 436], respectively, indicated the presence of averages amounting to

15 and 12 per cent. of the original chlordane after 12 years and of 41 and 8 per cent. of the original γ BHC after 11 years, the differences possibly indicating that the insecticides had broken down into non-toxic compounds that were still detected by colorimetric analysis. Bioassay of soils treated with heptachlor and aldrin indicated the presence of insecticide; chemical analysis showed no heptachlor and little aldrin and indicated that the toxicants were heptachlor epoxide and dieldrin, respectively [*cf.* **47** 56].

Comparison of the results obtained with aldrin in turf and with the same material applied to loam plots in Wisconsin, in which the insecticide was rototilled into the soil immediately after application and the soil was cultivated at intervals, showed that the compound persisted for considerably longer in the tilled soil, though the rate of dieldrin formation was about the same.

Cartier (J. J.). **Recognition of three biotypes of the pea aphid from southern Quebec.**—*J. econ. Ent.* **52** no. 2 pp. 293–294, 2 graphs, 4 refs. Menasha, Wis., 1959.

The following is based on the author's abstract. When three lines of *Macrosiphum pisum* (Harris) derived from single apterae collected in Quebec were reared simultaneously for nine days at 69°F., each on one susceptible and two resistant varieties of pea, the mean weights of the females averaged 3·4, 2·6 and 2 mg. on the susceptible and 2·4, 1·4 and 1 mg. on the more resistant variety, and the mean numbers of progeny per three females were 192, 134 and 101 on the first and 75, 20 and 35 on the second. The decline in rate of reproduction was accompanied by overactivity in the females, suggesting that they failed to obtain enough food from the resistant plants. Nymphs born on resistant plants were not overactive, but their reduced adult weight indicated that they had been underfed.

Chiang (H. C.) & Hodson (A. C.). **Distribution of the first-generation egg masses of the European corn borer in corn fields.**—*J. econ. Ent.* **52** no. 2 pp. 295–299, 4 graphs, 8 refs. Menasha, Wis., 1959.

Observations in 20 fields in Waseca, Minnesota, in 1948–57 showed the presence of 0–380 first-generation egg-masses of *Ostrinia* (*Pyrausta*) *nubilalis* (Hb.) per 100 plants of field maize, the variation being due to the fluctuations in the borer population in the area and the different attractiveness of the plants in the field. As the mean density of egg-masses increased, the proportion of plants with none decreased and the proportion with high numbers increased, but the differential attractiveness of the plants was not great and the distribution of egg-masses was essentially random, though it showed some tendency towards that termed contagious. The pattern of distribution on the plants in a given field was uniform throughout the oviposition period.

The percentage of plants with one or more egg-masses (frequency index) was found to be directly proportional to the highest number of egg-masses found alive on any one day (egg-mass count), and it is suggested that it should be substituted for this as an indication of the density of the egg population [*cf. R.A.E.*, A **40** 242], as its determination involves less labour. A frequency index of 60 per cent. was found to be equivalent to an egg-mass count of 50, which is sometimes considered the critical level of infestation for the application of control measures.

Sullivan (W. N.) & Thompson (C. G.). **Survival of insect eggs after stratospheric flights on jet aircraft.**—*J. econ. Ent.* **52** no. 2 pp. 299–301, 2 figs., 5 refs. Menasha, Wis., 1959.

The following is substantially the authors' abstract. Studies were made to determine whether insect eggs on the exterior surfaces of jet aeroplanes survive flights in the stratosphere. The first flight was at 40,000 ft. for eight minutes at Mach 0·82 (465 knots true air speed) and an air temperature of – 57°C. [– 70·6°F.], and the second was at 45,000–50,000 ft. for 30 minutes, with 12 minutes above Mach 1, and an air temperature of – 60°C. [– 76°F.]. In both tests, there was complete mortality of eggs of *Prodenia ornithogalli* Gn., a representative species of Noctuidae, which are the only family reported as laying eggs on aircraft, but a normal hatch of those of *Malacosoma americanum* (F.), which were tested because of their resistance to cold.

Brazzel (J. R.) & Gaines (J. C.). **The toxicity of several insecticides to the eggs and larvae of the pink bollworm.**—*J. econ. Ent.* **52** no. 2 pp. 301–303, 1 graph, 9 refs. Menasha, Wis., 1959.

Laboratory tests in Texas in 1956, in which groups of ten eggs of *Pectinophora gossypiella* (Saund.) were treated with acetone solutions of nine organic insecticides at various concentrations, showed that Guthion and parathion were much more effective (approximately 0·01 per cent. LC50) than any other material and that lindane [almost pure γ BHC], endrin, and DDT were more effective than dieldrin, malathion, heptachlor or toxaphene. When bolls were artificially infested under the calyx with eggs and treated in a spray chamber with commercial emulsion concentrates of the same insecticides less than 12 hours before they hatched, examination ten days later showed significant reductions in hatch after treatment with 0·25 lb. technical parathion or Guthion per acre and non-significant reductions after all other treatments. All treatments significantly reduced the percentage of larvae that entered the bolls, but Guthion and 1·5 lb. DDT per acre were much the most effective, giving 80·6 and 70·5 per cent. control, respectively, as compared with 22·3–53·1 per cent. for the other materials. The results indicated that, although ovicidal action caused some mortality, the main controlling effect of sprays was on the young larvae that hatched below the calyx and attempted to enter the exposed part of the boll above the calyx. In the field, this would be additional to the effect on adults.

Hopkins (A. R.), Fye (R. E.) & Walker (R. L.). **The residual action of Thimet and Bayer 19639 against the cotton aphid and the greenbug.**—*J. econ. Ent.* **52** no. 2 pp. 304–305, 1 ref. Menasha, Wis., 1959.

Side dressings of 10–30 lb. phorate (Thimet) per acre, applied in granules to cotton plants at Florence, South Carolina, on 25th May 1956 [*cf. R.A.E.*, A **47** 66], gave good control of *Aphis gossypii* Glov. in August 1956 and also on the next year's crop in August 1957. Caging aphids on plant terminals cut from this crop confirmed the persistent effect of the phorate.

In tests made in 1957, Bayer 19639 [O,O,-diethyl S-2-(ethylthio)ethyl phosphorodithioate] was more effective than phorate in reducing aphid populations in August, when applied at 1 lb. per acre as a seed treatment

in carbon or in granules in the furrow. Phorate was no more effective as a seed treatment in cotton-seed oil, with or without emulsifier, than in carbon, and the cotton-seed oil seriously interfered with germination. Side dressings of 10–20 lb. phorate or 19639 per acre, applied on 24th May 1957, all gave very good control of *A. gossypii* on 19th August, with no difference between plots that had or had not received the furrow treatments. As small grains, which often follow cotton in rotation in South Carolina, may be seriously damaged by *Toxoptera graminum* (Rond.), these plots were sown with oats in October and examined for infestation on 27th November. Highly significant reductions in population on all treated plots, as compared with untreated ones, indicated that high rates of phorate or 19639 may have a long residual action against some insects in the sandy loams common to the coastal plains of South Carolina.

Brazzel (J. R.) & Martin (D. F.). **Winter survival and time of emergence of diapausing pink bollworms in central Texas.**—*J. econ. Ent.* **52** no. 2 pp. 305–308, 2 graphs, 1 ref. Menasha, Wis., 1959.

Pectinophora gossypiella (Saund.) did not cause economic injury to cotton in central Texas until 1954, when a late crop of bolls due to rainfall in the second half of July permitted a rapid increase in population [*cf. R.A.E.*, A **46** 440]. Heavy infestation late in the year and poor stalk destruction resulted in large populations of larvae in diapause and heavy infestations early in 1955.

The effect of environment on the survival of overwintering larvae and the time of emergence of the adults was investigated in 1953–55. Infested seed cotton was spread on the ground under screen cages in October 1953 and December 1954, and 65·8 and 93·4 per cent. of the larvae transformed to adults and emerged between 1st January and 1st September in 1954 and 1955, respectively; 83 and 77·3 per cent. of all emergences occurred in May–June, with most in the first two weeks of June, when cotton fruiting was heavy. Emergence decreased immediately mean temperatures fell below 70°F., and after 2–3 weeks without rain, regardless of high temperatures, but increased within 10–14 days after half an inch of rain had fallen.

Fye (R. E.), McMillian (W. W.), Walker (R. L.) & Hopkins (A. R.). **The distance into woods along a cotton field at which the boll weevil hibernates.**—*J. econ. Ent.* **52** no. 2 pp. 310–312, 2 refs. Menasha, Wis., 1959.

Investigations on the distance to which adults of *Anthonomus grandis* Boh. enter woods adjoining cotton fields in order to hibernate were made at Florence, South Carolina, in 1957–58. Samples of the débris on 2 sq. yards of soil were taken at intervals of 15 ft. over a distance of 350 ft. into the woods in spring and autumn, and examination of these showed that 90 per cent. of the weevils hibernated within the first 180 ft., though some penetrated to a distance of 300 ft. [*cf. R.A.E.*, A **47** 28]. Numbers were greatest 30–45 ft. from the border. There was no indication that the depth of the débris had any effect on the choice of hibernation site, maximum populations occurring at depths of 0·5–3 in., with no one depth predominating, but there was a definite preference for deciduous over pine leaf material and for moist rather than wet or dry débris.

It is concluded that since measures for the control of hibernating adults of *A. grandis* would need to be applied over large areas, only methods that were either inexpensive or effective for several years would be justifiable.

Lindgren (D. L.) & Vincent (L. E.). **Biology and control of** *Trogoderma granarium* **Everts.**—*J. econ. Ent.* **52** no. 2 pp. 312–319, 1 graph, 1 ref. Menasha, Wis., 1959.

In further laboratory investigations on the bionomics and control of *Trogoderma granarium* Everts in California [*cf. R.A.E.*, A **44** 445], the Dermestid completed a single generation in 1–2·5 months on 23 foods offered to it, mostly of vegetable origin, and failed to complete one in 6–12 months on 16 others; different quantities of different foods were required, individual larvae giving rise to adults on as little as 4 mg. whole wheat flour but failing to mature on 8 mg. maize meal or rice flour. When successive generations were allowed to develop in 50-g. samples of various foods at temperatures of 80–100°F., the rate of consumption increased as the temperature rose; the proportion consumed in four months at 100°F. varied from about 5 per cent. for whole peas, soy beans and pinto beans to 90 per cent. for whole and cracked wheat, heavy populations developing rapidly in the latter, whereas numbers remained low in the whole grain.

The periods required for 95 per cent. mortality of eggs at temperatures of 120, 126 and 135°F. were 228–232, 20 and 3 minutes, respectively; changes in relative humidity from 25 to 75 per cent. did not affect the results. Limited tests on the effect of fluctuating temperatures on the life-history of the beetle indicated the occurrence of both short- and long-lived individuals; development from egg to adult was more rapid at fluctuating than at corresponding constant temperatures. There were about two generations a year on ground cracked wheat in the shade at Riverside. Some larvae in the third and fourth instars survived exposure to a relatively pure atmosphere of carbon dioxide for 14 days, but none survived for 19 days. When larvae in these instars were exposed to temperatures of 14–20°F. for 8–57 days, larvae that had been starved for 254 days appeared to be more resistant to cold and fed larvae less so than those that had been starved for 27 days. Starvation had little or no effect on the susceptibility of larvae to fumigation with acrylonitrile for two hours at 75°F., but starved larvae appeared to be less susceptible than fed ones to hydrogen cyanide, ethylene dibromide or methyl bromide. When 100,000 larvae were placed on wheat in a cylinder 14 in. in diameter and 4 ft. high and the latter was kept for about 15 months at constant temperatures that were varied from 80 to 65, 80 and 100°F., the temperatures at a depth of 6 in. were 102 and 105–107°F. when room temperatures were 80 and 100°, but only 70° when room temperature was 65°; at the end of the test, 190 larvae and 6 g. frass were present in a 52-ml. sample at this depth and 7 larvae and 0·2 g. frass in one from a depth of 38 in.

There was little difference in the viability of eggs kept at relative humidities of 10–65 per cent., but a slight reduction at 0 or 100 per cent., and little variation in the average minimum developmental period from egg to adult at 10–95 per cent., but a slight lengthening of it at zero humidity; the insects could survive and reproduce under dry conditions, females producing 31–88 eggs each at 95°F. and zero humidity. Attempts to rear *T. granarium* on growing wheat in the greenhouse were unsuccessful.

Spraying wheat that contained 10–14 per cent. moisture with 8–16 parts malathion per million controlled larvae of *T. granarium* subsequently introduced, but allethrin, Chlorthion, aldrin, γ BHC (lindane), DDD, DDT and

Pyrocide 175 (20 per cent. pyrethrins) were ineffective. Investigations on the penetration of methyl bromide into soil showed that doses of 0·05, 0·1, 0·4 and 1 lb. per 100 sq. ft., allowed to evaporate under a tarpaulin over the surface, gave complete kill of the larvae in 24 hours at depths of 9, 15, 21 and 30 in., respectively. The lowest dosage necessary for complete kill of mature larvae fumigated in an empty chamber with acrylonitrile, ethylene chlorobromide, ethylene dibromide, hydrogen cyanide or methyl bromide increased as the exposure period was reduced from 48 to 2 hours and as the temperature fell from 90 to 50°F. For exposures of 24 hours at 70°F., higher doses were needed in a chamber half full of wheat than in an empty one, at 14 per cent. moisture content of the grain than at 7 per cent., and at a depth of 6 in. than at the surface; the differences were least for methyl bromide, which gave complete mortality at 0·53 and 1·24 lb. per 1,000 cu. ft. in the empty chamber and at a depth of 6 in. in wheat containing 14 per cent. moisture, respectively.

Strong (R. G.) & Lindgren (D. L.). **Effect of methyl bromide and hydrocyanic acid fumigation on the germination of barley.**—*J. econ. Ent.* **52** no. 2 pp. 319–322, 7 refs. Menasha, Wis., 1959.

Samples of four varieties of barley, with moisture contents adjusted to 8, 10, 12 and 14 per cent., were fumigated for 72 hours with various doses of methyl bromide at temperatures of 50, 70 and 90°F., and samples of one were treated with methyl bromide and hydrogen cyanide under varying conditions of temperature, exposure and dosage. Half the samples were fumigated once and half twice, and germination tests were made within five days of fumigation and after 84 days of storage at 50°F. [*cf. R.A.E.*, A **48** 218]. Under the conditions used, fumigation with 1–3 lb. HCN per 1,000 cu. ft. did not affect germination, but treatment with 1–6 lb. methyl bromide killed some seed; there was little evidence of retarded emergence of seedlings. Increases in dosage, period of exposure (between 2 and 72 hours), temperature and moisture content of the seed contributed slightly to decreases in germination after fumigation, but barley was highly tolerant to methyl bromide under the most extreme conditions. A second fumigation reduced germination slightly in some cases. No significant difference was observed in the reduction of germination immediately after fumigation and after storage.

Lyon (R. L.). **Toxicity of several residual-type insecticides to selected western bark beetles.**—*J. econ. Ent.* **52** no. 2 pp. 323–327, 4 graphs, 4 refs. Menasha, Wis., 1959.

With a view to developing the use of sprays for the control of bark-beetles attacking coniferous forest trees in California, selected insecticides were tested for toxicity to *Dendroctonus brevicomis* Lec., *D. ponderosae* Hopk. (*monticolae* Hopk.), *Scolytus ventralis* Lec., and *Melanophila californica* Van Dyke by topical application in acetone solution [*cf. R.A.E.*, A **46** 427]. Tests with adults that had emerged not more than six hours earlier showed that the LD90's in μg. per g. body weight for *D. brevicomis* were 9·6, 10·9, 17·4 and 19·1 for endrin, isodrin, lindane [almost pure γ BHC] and EPN and increased progressively from 83·2 to 201·3 for dieldrin, DDT, heptachlor and DNC. Those for *D. ponderosae* were 4·7, 5·7, 5·8 and 6·7 for γ BHC, isodrin, endrin and EPN and increased from 19·5 to 96·2 for dieldrin, heptachlor, DNC and DDT. Those for *S. ventralis*

were 0·79 and 0·85 for isodrin and endrin and increased from 1·72 to 29·08 for dieldrin, γ BHC, EPN, DDT and DNC, and those for *M. californica* increased from 14·4 to 142·2 for isodrin, γ BHC, dieldrin and DDT.

PUTTLER (B.) & VAN DEN BOSCH (R.). **Partial immunity of *Laphygma exigua* (Hübner) to the parasite *Hyposoter exiguae* (Viereck).**—*J. econ. Ent.* **52** no. 2 pp. 327–329, 10 refs. Menasha, Wis., 1959.

In California, *Hyposoter exiguae* (Vier.) is a major parasite of *Heliothis zea* (Boddie) and also attacks other Lepidoptera, including *Spodoptera* (*Laphygma*) *exigua* (Hb.). In laboratory tests, in which *Spodoptera* larvae in the late first or second instar were exposed to oviposition by the parasite, a high proportion of those containing single eggs survived, and dissection showed that this was due to encapsulation of the egg by phagocytes (blood cells) of the host, which occurred in 92 per cent. of the larvae examined. In larvae containing more than one egg, the immunity was largely overcome, and dissection showed that, in general, only one egg was completely phagocytised. In superparasitised larvae containing more than two eggs, all unphagocytised eggs hatched, but only one parasite larva survived; the dead ones were eventually encapsulated. Observations on field-collected parasitised larvae confirmed these results, and it was evident that superparasitism favours survival of the parasite.

CUNNINGHAM jr. (W. H.), KING (D. R.) & LANGLEY (B. C.). **Insecticidal control of the lesser cornstalk borer on peanuts.**—*J. econ. Ent.* **52** no. 2 pp. 329–330. Menasha, Wis., 1959.

Elasmopalpus lignosellus (Zell.) has caused increasing damage to groundnuts in Texas in recent years, and field tests on its control were carried out in 1957. In sprays applied from each side of the row to cover the stems and the soil at their base, 0·4 lb. endrin in 20, 40 or 86 U.S. gal. emulsion spray per acre, applied on 3rd July and 2nd and 30th August, to coincide with the appearance of successive generations of the moth, caused significant reductions in the percentage injury, as estimated on 15th August and 19th October, and a significant increase in yield, with no significant difference between treatments. Single applications of 1·5 lb. DDT in 100 U.S. gal. emulsion spray per acre on 1st or 29th July or 27th August, and pairs of applications on any two of these dates, significantly reduced the percentage injury on 3rd October, and applications of 0·4 lb. endrin with 1·5 lb. DDT in 100 U.S. gal. emulsion spray per acre twice at intervals of 21 or 14 days or four times at 7-day intervals from late July all caused significant reductions in injury on 23rd August and 3rd October, but none of these treatments significantly increased the yield.

RIEHL (L. A.) & WEDDING (R. T.). **Effects of naphthenic and paraffinic petroleum fractions of comparable molecular weight on transpiration of Eureka lemon and Bearss lime plants.**—*J. econ. Ent.* **52** no. 2 pp. 334–335, 10 refs. Menasha, Wis., 1959.

Greenhouse tests, by methods already described [*R.A.E.*, A **47** 326], showed that the application of 1·75 per cent. aqueous emulsions of naphthenic and paraffinic oils, with molecular weights of 306 and 308, respectively, reduced the transpiration of both lime and lemon leaves on

the day after treatment by more than 50 per cent. The reductions were about the same for both oils and both species of *Citrus*, and the plants recovered with time, but more rapidly after the naphthenic than after the paraffinic sprays.

BARNES (O. L.). **Effect of cultural practices on grasshopper populations in alfalfa and cotton.**—*J. econ. Ent.* **52** no. 2 pp. 336–337, 8 refs. Menasha, Wis., 1959.

Studies in 1936–45 in the Salt River Valley of Arizona, where cotton and lucerne are the major crops and *Melanoplus bilituratus* (Wlk.) and *M. differentialis* (Thos.) the grasshoppers of most economic importance, showed that both grasshopper and weed populations increased with the age of the lucerne crop. A diet of lucerne alone is inadequate for the development of either species [*cf. R.A.E.*, A **44** 115], but lucerne with one or more of the weeds commonly found growing with it was found to be adequate for *M. bilituratus* in 1953–54.

Further investigations in 1954–57 showed that the average grasshopper population was about 15 times as great in lucerne as in cotton; evidently, a change from lucerne to cotton, which requires deep ploughing and clean cultivation, reduces the numbers. The average population increased with the age of the lucerne stand and was decidedly higher in weedy than in clean fields, regardless of the age of the stand, but the percentage of weedy fields increased with the age of the stand.

M. bilituratus and *M. differentialis* were clearly the dominant species on lucerne in 1954 but *Trimerotropis pallidipennis* (Burm.) predominated in 1955, with *M. differentialis* in third place, and though *M. bilituratus* was the commonest species in 1956, it was less abundant than *T. pallidipennis* in 1957. The decline of *M. bilituratus* and *M. differentialis* was probably due to mortality from insecticides applied against the spotted alfalfa aphid [*Therioaphis maculata* (Buckt.)], the favoured habitats of the other species being less restricted.

The surveys indicate that grasshopper populations can be reduced by shortening the period for which lucerne is grown continuously on the same land, by rotation of lucerne with cotton or other cultivated crops and probably by weed control in lucerne.

KIRK (V. M.). **Control of the corn earworm in grain sorghum heads.**—*J. econ. Ent.* **52** no. 2 pp. 338–339, 4 refs. Menasha, Wis., 1959.

Heliothis zea (Boddie) is an important pest of grain sorghum in South Carolina, where larval feeding in the heads causes over 50 per cent. loss of yield, due to missing or damaged kernels, in heavily infested fields. Heads are rarely attacked until they have half finished flowering, after which they are liable to damage for about a fortnight; up to 20 young larvae may occur per head, but these are reduced to 1–2 mature ones by cannibalism or other causes, and the heads are unlikely to be reinfested after these leave to pupate in the soil. DDT gave effective control on sorghum grown for seed in 1957, but cannot be used on that grown for animal feed. In tests in 1958, single applications of 12 U.S. gal. emulsion spray or 20–25 lb. dust per acre were made when the heads contained numerous young larvae, and Sevin at 2 lb. per acre in a dust and at 1 and 2 lb. in a spray gave 100, 92 and 94 per cent. control after three days and 93, 62 and 74 per cent. after 14; similar applications of DDT gave 94, 88

and 99 per cent. control after three days and 87, 91 and 93 per cent. after 14. These were the only materials that gave good control throughout the necessary two-week period, but they should be applied only to sorghum grown for seed. Of the other materials tested, 0·75 lb. Thiodan and 0·5 lb. Phosdrin in sprays and 0·5 lb. Phosdrin and mixtures of 1 or 2 lb. each of malathion and Sevin in dusts gave 78, 82, 79, 93 and 99 per cent. control after three days and were inadequate after 14. Phosdrin could be used on sorghum intended for feed, because of its short residual life, but would need to be applied repeatedly for good results.

Summers (F. M.) & Price (D. W.). **Emergence and development of the overwintered generation of peach twig borer larvae.**—*J. econ. Ent.* **52** no. 2 pp. 340–341, 1 graph, 2 refs. Menasha, Wis., 1959.

Anarsia lineatella Zell. overwinters under the soft bark of stone-fruit trees as an immature larva, generally in the second instar, after which it feeds on the new growth, and samples of about 250 hibernacula, taken from almond trees of four varieties in the Sacramento Valley, California, at short intervals from 29th January 1958, were dissected to find the proportions still occupied. Sampling was continued until all were empty, and the results showed that the resumption of activity continued for about 11 weeks, until 18th April, but was most rapid during the flowering period of almond or the late pink-bud stage of peach. Examination of larvae from shoot tips to find the proportions that were full-fed, made at intervals until no more were found, showed that almost the whole of the population was feeding in the twigs from 17th March, when 90 per cent. had left the hibernacula, to 11th April when 2 per cent. were mature; the maturing of larvae in the twig mines increased sharply after mid-April. Limited observations on peach in the San Joaquin Valley indicated a similar trend of activity, and the occurrence of similar hatching dates for the spring generation on the two plants over a number of years confirmed the results. Spraying against *A. lineatella* at the pink-bud stage or at 90 per cent. petal-fall is commonly recommended, and petal-fall applications are usually made on almond on 10th–20th March and on peach on 20th–30th March, but the results of the investigations indicated that almost the whole of the population is exposed to insecticides until about 10th April.

Mulkern (G. B.) & Anderson (J. F.). **A technique for studying the food habits and preferences of grasshoppers.**—*J. econ. Ent.* **52** no. 2 p. 342, 2 refs. Menasha, Wis., 1959.

The authors describe a technique by means of which the diets of grasshoppers can be determined from the contents of their crops. Permanent reference slides were made of the crop contents of grasshoppers that were caged on single plants of large numbers of species in the field or of plant samples chopped to a suitable size. For analysis studies, grasshoppers were collected with a sweep net in the area selected and preserved in 70 per cent. alcohol, and the plants in the area and their relative abundance were recorded. Microscopic comparisons of the crop contents of about 100 grasshoppers with the reference slides showed which plants were being eaten and which ignored, and this was recorded, with climatological and other pertinent information, including the insect species and instars used and the conditions of the plants or field. The grasshoppers can be collected at suitable times and stored until analysis is convenient,

some having been kept for a year without impairment of their value. Data obtained in this way are being used in a study of the feeding habits and preferences of grasshoppers in North Dakota.

Henneberry (T. J.), Smith (F. F.) & Taylor (E. A.). **Control of two-spotted spider mites with chlorbenside, ovex, and Tedion.**—*J. econ. Ent.* **52** no. 2 pp. 342–343, 6 refs. Menasha, Wis., 1959.

In tests on the control of *Tetranychus telarius* (L.) on outdoor plants at Beltsville, Maryland, in 1957, five weekly applications of 0·25 lb. wettable acaricide per 100 U.S. gal. were made on artificially infested roses; all sprays also contained zineb for fungus control, DDT and lindane [γ BHC] against insects, and a wetting agent. In the first test, in May–June, Tedion and chlorfenson (ovex) caused significantly greater seasonal reductions in mite populations than chlorbenside, and the latter was significantly better than no treatment; all reduced feeding injury significantly, but Tedion was significantly more and chlorbenside significantly less effective than chlorfenson. In a second test, in August–September, all treatments reduced seasonal mite populations significantly, and Tedion and chlorfenson appeared to be better than chlorbenside, though the differences were not significant.

In a similar schedule on lima beans in August–September, the fungicide and insecticides were omitted and an emulsion spray of chlorfenson was included in the comparison. All treatments reduced populations significantly after the third and later applications, with no significant difference between treatments, and all reduced feeding injury significantly, Tedion being significantly better than chlorbenside or chlorfenson in either formulation.

Walker jr. (J. K.) & Brazzel (J. R.). **A method for collecting diapausing boll weevils for hibernation studies.**—*J. econ. Ent.* **52** no. 2 pp. 346–347, 6 refs. Menasha, Wis., 1959.

Winter survival of autumn-collected adults of *Anthonomus grandis* Boh., transferred to hibernation cages, has generally proved low [*cf. R.A.E.*, A **31** 187; **32** 403], especially in those collected early. In investigations by J. R. Brazzel & L. D. Newsom, adults collected from cotton in the field in Texas in the autumn comprised an active reproducing group and a group in which the reproductive organs were in a state of physiological dormancy. Weevils hibernating in ground trash in winter all showed reproduction diapause. A method was therefore developed by which the weevils were allowed to separate into the two groups in laboratory cages, so that only those physiologically prepared for hibernation would be used for survival studies. Weevils collected at intervals from 8th September to 4th November were caged without further feeding, and others collected on 4th November were allowed to feed daily on cotton squares. Most of the latter were very active and fed freely, but they gradually stopped feeding, became sluggish and assumed the characteristic hibernation posture, and successive batches of these were caged on 13th–21st November and 3rd December. Records made in April–June 1958 showed that less than 1 per cent. emerged from hibernation in six of the ten cages containing unfed weevils and 2·4–4 per cent. in the other four, probably because many individuals were not physiologically ready for hibernation, whereas 19·3 and 13·8 per cent. of those that had been fed until they

entered diapause survived. The resumption of activity was completed in April and May, and 52·6 and 60 per cent., respectively, of the weevils that appeared in these two months were males.

GREEN (H. B.). **Imported fire ant mortality due to cold.**—*J. econ. Ent.* **52** no. 2 p. 347. Menasha, Wis., 1959.

Solenopsis saevissima richteri Forel has spread northward through much of the south-eastern United States in recent years [*cf. R.A.E.*, A **38** 34, 371], and its northern limits of survival are unknown. It has survived temperatures of about 0°F. in east-central Mississippi for several years, but some mortality due to cold was observed there in early 1958. This did not substantially reduce the number of colonies, but greatly affected the strength of many of them, apparently reducing the number of sexual forms produced in spring. The colonies most seriously injured were those that had moved to new positions and had built new mounds after early frosts, the mounds not being reinforced with grass stems. Winter rains and subsequent mild weather, during which the ants built the mound, were succeeded by frost, which immobilised them in all parts of the mound, and these conditions were followed by a thawing rain, which caused the galleries to collapse, and further severe and protracted frost, which killed all the ants but those at the lower levels. Such conditions are rare in Mississippi, but might limit the spread of the ant further to the north.

MANSON (G. F.) & MILES (J. R. W.). **Rubber latex paint for separating pesticide deposits on upper and lower surfaces of leaves.**—*J. econ. Ent.* **52** no. 2 pp. 347–348, 3 refs. Menasha, Wis., 1959.

A method was devised for determining the proportions of insecticide residue on the upper and lower surfaces of tobacco leaves after application by aeroplane or ground equipment. At selected locations in the field, leaves were painted with rubber latex emulsion over half the upper surface before the application of the insecticide; after the dusting or spraying, disks were punched from the painted and unpainted parts, and the latex film removed with forceps. The insecticide was extracted in the laboratory, and chemical analysis of 40 samples by specific methods indicated average residues of 9·7 and 1·4 μg. per sq. cm. on the upper and lower surfaces, respectively. Gravimetric determination of dusts deposited on horizontal oil-covered plates showed deposits of 78 and 26 mg. on the upper and lower surfaces, and the difference in the ratios indicates that deposits on foliage differ from those on artificial surfaces.

DOUCETTE (C. F.). **Soil drenches for control of the narcissus bulb fly.**—*J. econ. Ent.* **52** no. 2 p. 348, 3 refs. Menasha, Wis., 1959.

Drenches prepared from emulsion concentrates of aldrin or heptachlor or a 50 per cent. soluble powder containing trichlorphon (Dipterex) were tested for the control of *Merodon* (*Lampetia*) *equestris* (F.) on narcissus bulbs in the soil at Sumner, Washington, in 1955, 1957 and 1958. The drench was applied in a stream from a compressed-air sprayer without a nozzle, directly at the neck of the bulb, and gave more penetration of the insecticide into the soil than do sprays [*cf. R.A.E.*, A **32** 270]. A single

application of 2 lb. aldrin or 1 lb. heptachlor or trichlorphon per 100 U.S. gal. was made at the beginning of adult activity, as indicated by emergence from infested bulbs in field cages. This was in May or June, and all treatments reduced the infestation of mature bulbs from 7–71 to less than 3 per cent.

Grigarick (A. A.). **A floating pan trap for insects associated with the water surface.**—*J. econ. Ent.* **52** no. 2 pp. 348–349, 1 fig. Menasha, Wis., 1959.

A trap that proved satisfactory for sampling the adult population of *Hydrellia griseola* (Fall.) in rice-fields in California consisted of an aluminium pan, 8 in. in diameter and 1·25 in. deep, set in a wooden float. This was attached to two uprights, so that it could not drift, but could rise and fall with the water level. The pan contained water with a little wetting agent, to lower its surface tension and cause alighting insects to sink to the bottom, where they accumulated in a small depression in the centre. The insects taken were removed every 1–3 days and included a wide variety of species in 11 Orders, which suggests that the trap might be used for investigations on other insects associated with the water surface.

Steinhaus (E. A.). **Granuloses in two Alaskan insects.**—*J. econ. Ent.* **52** no. 2 pp. 350–352, 2 figs., 1 ref. Menasha, Wis., 1959.

Diseased larvae of *Euxoa ochrogaster* (Gn.) collected during an outbreak of this cutworm in the Matanuska Valley of Alaska were received in June 1958 and found to be infected with a granulosis virus that may have been the cause of a disease reported in this insect in Saskatchewan in 1928 [*R.A.E.*, A **16** 640].

Diseased larvae of *Eulype hastata* (L.) were received in August of the same year from an area to the south-east of Fairbanks, Alaska, where an outbreak of this Geometrid had caused moderate to heavy defoliation of white birch [*Betula alba*] over an area of nearly six million acres. A sharp decline in the population had been noted shortly before the specimens were collected, when the larvae were in the third and fourth instars; some of this was due to insect parasites, but a granulosis virus found in the larvae was probably the primary cause. Of one sample of 14 larvae, six were infected with a combination of *Entomophthora* sp. and Microsporidia (*Nosema*) and seven with the granulosis virus and the Microsporidia, and one appeared to have died of a combined infection of virus and bacteria; however, the granulosis predominated in all the samples examined. The summer had been warmer than usual, with an average humidity of about 65 per cent.

English (L. L.). **Control of the bagworm with Dibrom.**—*J. econ. Ent.* **52** no. 2 p. 353. Menasha, Wis., 1959.

In tests in Illinois in 1957, applications of an emulsion concentrate containing 4 lb. Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) per U.S. gal. gave complete kills of larvae of *Thyridopteryx ephemeraeformis* (Haw.) on arbor-vitae [*Thuja occidentalis*], blue spruce [*Picea pungens*] or juniper [*Juniperus*] at 0·5–2 pints per 100 gal. water on 9th July, when the bags were about half an inch long, at 0·5–1 pint on 15th

July, at 1 pint on 22nd July and at 2 quarts on 5th August, when the larvae were almost mature. Mortality was not complete with 0·125–0·25 pint per 100 gal. on 15th July and was 44·4 per cent. with 2 quarts on 21st August, when half the larvae had pupated. No mortality was obtained when bagworms were caged on plants that had been sprayed with 0·5–2 pints of the concentrate per 100 gal. eight days before, indicating a short residual effect and the need for thorough and complete spray coverage. In 1958, a spray prepared from a different emulsion concentrate gave complete kill of a heavy infestation on juniper on 19th August, when 10 per cent. of the larvae had reversed in the bags and 80 per cent. appeared to have stopped feeding. None of the treatments injured the plants.

Miskus (R.) & Hassan (S.). **Preassay activation of Thimet.**—*J. econ. Ent.* **52** no. 2 pp. 353–355, 1 graph, 5 refs. Menasha, Wis., 1959.

The authors describe modifications that were found necessary to make the method used to increase cholinesterase inhibition by Bayer 19639 [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate] for residue analysis [*R.A.E.*, A **48** 220] suitable for activating the related compound phorate (Thimet). These included carrying out the oxidation with a mixture of hydrogen peroxide and acetic acid in chloroform instead of benzene, at a lower temperature and with frequent shaking. Oxidation for ten minutes resulted in optimum *in vitro* anticholinesterase activity. Longer oxidation seemed to reduce the inhibitory power of the compound, but tests on its metabolites [*cf.* **46** 229] before and after oxidation showed little change in the inhibitory power of any of them under the conditions that would be used for residue analysis.

Strong (R. G.), Sbur (D. E.) & Pieper (G. R.). **Effect of several pesticides on the germination of three varieties of flower seeds.**—*J. econ. Ent.* **52** no. 2 p. 355, 1 ref. Menasha, Wis., 1959.

With a view to using acaricides to eliminate mites that consistently infested the seeds of three of more than 1,100 varieties of flowers stored in a warehouse in California, the effect of undiluted wettable powders on the germination of seeds of *Centaurea cyanus*, *Iberis umbellata* and *Alyssum procumbens*, with moisture contents of 6·6–6·9 per cent., was tested. It was found that powders containing 15 per cent. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], 18·5 per cent. Kelthane, 25 per cent. chlorobenzilate, Tedion or malathion or 50 per cent. chlorfenson (ovex), thoroughly mixed with the seeds at a rather high rate (1:10) 1–26 weeks before sowing, did not seriously reduce germination.

Harding (J. A.). **Potato aphid control on tomatoes.**—*J. econ. Ent.* **52** no. 2 pp. 355–356, 5 refs. Menasha, Wis., 1959.

In tests of seven recently developed insecticides for the control of *Macrosiphum euphorbiae* (Thos.) (*solanifolii* (Ashm.)) on tomato in Texas, 1 lb. active ingredient in 20 U.S. gal. spray per acre was applied to the lower leaf surfaces of ten-inch plants in April 1958, and the living aphids on five leaves per plot were counted 1, 4 and 7 days later. Differences between treatments were not significant at the first count, but Sevin, malathion, diazinon and Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate)

appeared to have the greatest initial toxicity. The first two rapidly lost effectiveness [*cf. R.A.E.*, A **45** 17], but all materials except ethyl-DDD (Perthane) were still effective after four days. After seven days, diazinon, Dibrom, Trithion and ronnel [O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate], of which the last two appeared to be slow in action, were better than Sevin, malathion and ethyl-DDD. No phytotoxic effects were noted.

Wright (C. G.). **The influence of two insecticides on the emergence of *Lyctus planicollis* Lec.**—*J. econ. Ent.* **52** no. 2 pp. 357–358, 1 ref. Menasha, Wis., 1959.

In laboratory tests on the control of *Lyctus planicollis* Lec., split oak billets were infested by caging them with males and females until these died. Ten weeks later, the samples were painted with melted paraffin wax at both ends, to prevent longitudinal penetration of chemicals, totally immersed in 2 per cent. chlordane emulsion, 0·5 per cent. dieldrin emulsion, water or the inert ingredients of each emulsion for two hours and allowed to drain. Comparison of treated with untreated samples at intervals for a year showed that both insecticides gave complete control of *L. planicollis* and that immersion in the inactive ingredients reduced the mean number of emerging adults from about 40 for no treatment, or immersion in water, to 4–13; the ratio of males to females was the same for all treatments and for none. There was a direct correlation between the number of adults that emerged and the loss in weight of the wood in all but two samples.

Pollard (H. N.), Turner (W. F.) & Kaloostian (G. H.). **Invasion of the southeast by a western leafhopper, *Homalodisca insolita*.**—*J. econ. Ent.* **52** no. 2 pp. 359–360, 2 figs., 3 refs. Menasha, Wis., 1959.

Homalodisca insolita (Wlk.), which has spread to eastern Texas, Louisiana, Arkansas, Tennessee, Mississippi, Alabama, Florida and North and South Carolina and is a possible vector of the virus that causes phony peach disease [*cf. R.A.E.*, A **45** 32; **47** 226], was first taken in the United States in 1950, when two examples were found on 5th October on adhesive traps that had been exposed since 29th September at Fort Valley, Georgia. Nine were taken at the same place in 1951, and 105, indicating an explosive increase in population, in 1952, two months after the first adult was swept from vegetation near the trap. *H. insolita* was readily swept from Johnson grass (*Sorghum halepense*) soon after, and close examination revealed the presence of immature stages on that plant. Numbers continued to increase in later years. It is assumed that the establishment of *H. insolita* at Fort Valley constituted part of a general invasion as the Cicadellid progressed from west to east.

Whitnall (A. B. M.). **An orchard mite resistant to organophosphorus insecticides.**—*J. ent. Soc. S. Afr.* **21** no. 2 pp. 239–248, 2 graphs, 15 refs. Pretoria, 1958.

The following is based largely on the author's summary. *Tetranychus telarius* (L.) became a serious pest of deciduous fruit trees in the western Cape Province of South Africa shortly after 1946–47 [*cf. R.A.E.*, A **45** 371],

when the use of DDT for control of the codling moth [*Cydia pomonella* (L.)] became widespread and caused the destruction of the predators that had previously kept the mite under almost complete control. Chemical measures against the mite were then adopted, and schedules of two parathion sprays at 0·025 per cent. active ingredient, which was first used commercially in 1948–49, or of malathion at 0·075 per cent., which was first used in 1952–53, both proved successful; a single spray of 0·05 per cent. methyl-demeton also gave excellent control. In 1956–57, however, all these materials failed to control the mite on seven farms in the Elgin district, especially on a large estate where the trees were grown with a grass cover. Experiments on apple trees at a neighbouring farm established that organic phosphorus compounds at the recommended dosages had little effect on the mites, even after two applications. Two treatments with the systemic toxicant, amiton oxalate, at 0·02 per cent. reduced the population somewhat, but in the previous season this material had given superior control at one-tenth of that concentration. On the other hand, chlorinated hydrocarbons, chlorfenson at 0·025 per cent., chlorbenside at 0·05 per cent. and, especially, Kelthane at 0·037 per cent., controlled the mites. It therefore appeared that *T. telarius* had developed a resistance to organophosphorus compounds in certain localities, and this was confirmed in experiments carried out simultaneously in the Elgin district and in one other, in which sprays of parathion, methyl-demeton, amiton oxalate and Kelthane proved equally effective in the latter, but only Kelthane gave control in the former. This is the first record of the development of a mite resistant to organophosphates in South Africa. The development may have been hastened by the practice of cultivation under grass adopted on the one estate, since organophosphates were applied 33 times there over a period of eight years, whereas in clean-cultivated orchards only half this number was sufficient for satisfactory control.

Phelps (R. J.) & Oosthuizen (M. J.). **Insects injurious to cowpeas in the Natal Region.**—*J. ent. Soc. S. Afr.* **21** no. 2 pp. 286–295, 2 graphs, 1 map, 5 refs. Pretoria, 1958.

Cowpeas constitute an important green manure and hay crop in summer-rainfall areas of South Africa and provide the staple food of Africans elsewhere. The plants are attacked by a wide range of insects, and in some localities seed production is rendered uneconomic by seed-infesting species. During 1953–55, a survey of the occurrence and importance of injurious insects, some of the results of which have already been noticed [*cf. R.A.E.*, A **46** 109], was carried out in the Natal Region, mostly on sowings made at weekly intervals between December and February, and in this paper the species represented are listed and the fluctuations in numbers of the weevils, *Apion* (*Piezotrachelus*) *varium* Wagn. and *A. chirindanum* Wagn., considered together, and of insects of other Orders, also considered together, are illustrated on graphs and discussed. In 1953–54, the total percentage of seeds damaged by insects was 30·3 and the percentages of pods and of seeds infested by *A. varium* and of seeds damaged by *Melanagromyza albisquama* (Mall.) were 24·5, 14·9 and 6·8, respectively, and in 1954–55 the total percentage of damaged pods and the percentages damaged by *A. varium* and *M. albisquama* in the crop sown on 14th December 1954 were 51·7, 13·2 and 18·1, respectively. The larvae of *M. albisquama*, which had not previously been recorded attacking cowpeas, mine within the pods, each of which contains several, and usually damage all the seeds in them, though individual seeds are not

completely destroyed. Adults of *Callosobruchus* (*Bruchus*) *chinensis* (L.) were observed in the field soon after the first pods were formed. In 1954–55, the percentage of freshly picked pods damaged by this Bruchid was only 1·9, but its reproductive potential is high and it may cause serious damage to stored seeds. Hemiptera showed a marked peak in population when the green pods were present; large populations of Pentatomids, Coreids and Lygaeids cause shrivelling of the pods and wilting of the shoots, as well as injury to the immature seeds, and these insects may also transmit virus diseases. As many as six individuals were recorded from a single pod, and infestations of this order result in severe damage. Larvae of *Maruca testulalis* (Geyer) caused considerable damage to the green pods. Of the species that feed on the leaves, considerable defoliation was caused by small numbers of *Zonocerus elegans* (Thnb.) and larvae of *Anticarsia irrorata* (F.) and, especially on seedlings, by large numbers of several other Coleoptera.

VANDERPLANK (F. L.). **The assassin bug, *Platymerus rhadamanthus* Gerst (Hemiptera: Reduviidae), a useful predator of the rhinoceros beetles *Oryctes boas* (F.) and *Oryctes monoceros* (Oliv.) (Coleoptera: Scarabaeidae).**—*J. ent. Soc. S. Afr.* **21** no. 2 pp. 309–314, 1 ref. Pretoria, 1958.

Although *Oryctes boas* (F.) and *O. monoceros* (Ol.) cause severe damage to coconut palms in Zanzibar, a high degree of natural control prevails. This was formerly attributed to parasitism by *Scolia ruficornis* F., which in consequence was introduced into other coconut-growing countries. Surveys in Zanzibar, however, have shown that in fact it attacks less than 10 per cent. of the larvae, and this is considered to be insufficient to give control. In a plantation in which large compost heaps provided favourable breeding conditions for *Oryctes*, but in which damage by it nevertheless appeared to be lighter than elsewhere, large numbers of dead adults of this beetle were found in débris in the axils of the leaves of the palms, together with living adults of the Reduviid, *Platymeris rhadamanthus* Gerst. The body contents of most of the beetles had been entirely consumed, and there was a hole between the head and thorax, through which, in those that appeared to have been recently killed, small ants were often seen feeding. When adults of the Reduviid were offered living males and females of *Oryctes*, they immediately killed them by piercing the membrane between the head and thorax and fed on them for 2–3 hours; the ants evidently enlarged the puncture later.

Observations were accordingly made on the bionomics of *P. rhadamanthus*, all stages of which are described. The eggs hatched in 28–30 days at about 80° F. if kept on a moist substrate; they survived desiccation for 96 days, and then hatched 20–26 days after coming into contact with moisture. There were five nymphal instars, and total development lasted from 168 days to one year. The adults survived for over four months in the laboratory, and the females laid 2–5 eggs a day when abundant food was provided. Mating was not observed. In the field, the young nymphs frequently occurred in shady parts of the palm crowns during the day, but the older nymphs and adults remained in crevices and, more frequently, the débris in the axils of the leaves. In the laboratory, nymphs and adults fed on a wide range of insects, but in the field they were more specific; no beneficial insects were attacked. The bug was observed frequently in the field, and all stages were present throughout the year. All stages succumb to very minute dosages of synthetic contact insecticides.

The author suggests that *P. rhadamanthus* might be of value against *Oryctes* in other countries and points out that it could readily be transported by air in the egg stage or as nymphs in the second–fourth instar, which can survive for 3–4 weeks without food in a moist atmosphere at 80°F.

Other factors that check damage by *Oryctes* in Zanzibar include the practice of burying all decaying vegetation, and virus and fungus diseases, which, in the opinion of P. Surany, following a survey in July 1957, cause high mortality of the larvae.

Schöll (S. E.) & Daiber (C. C.). **Notes on the occurrence of holocyclic overwintering of the green peach aphid in South Africa.**—*J. ent. Soc. S. Afr.* **21** no. 2 pp. 315–322, 1 graph, 13 refs. Pretoria, 1958.

Although *Myzus persicae* (Sulz.) damages many plants in South Africa and is probably also of importance there as a vector of virus diseases of potato, its bionomics have not been studied, and investigations were accordingly begun in 1956. Spring infestations have occurred on peach at places between latitudes 26 and 31°S for many years, but, in view of the mild climate, were thought to have originated from migrants rather than from winter eggs. An examination of the literature showed that holocyclic development, with the production of winter eggs, does not occur between latitudes 40°N and S, except for one record at latitude 35°S in Victoria, Australia [*cf. R.A.E.*, A **22** 482], where peach trees were seriously damaged by fundatrigeniae. Examples collected on peach in Pretoria (latitude about 26°S) during the spring of 1956 also showed morphological characters of fundatrigeniae, and studies on the overwintering of the aphid in different climatic zones of South Africa begun in 1957 showed that it overwinters both anholocyclically and holocyclically on the high plateau. Pretoria is the farthest north and has the warmest winter climate of all the localities where holocyclic overwintering was observed and is also very near the northern limit of the region in which *M. persicae* occurs on peach. Investigations there are described.

Abundant primary and secondary food-plants are available in winter throughout Pretoria, since peach trees are common, cabbages are cultivated fairly extensively, and many other plants are in full foliage. Observations on the forms of *M. persicae* present were made on peach trees and in cabbage fields, as well as by means of catches in Moericke traps [**45** 315] and a suction trap. Gynoparae and immature sexual females were first observed on peach on 14th May, mating was first observed on 25th May, migration to the peach trees reached its peak at the end of May and the beginning of June, and the first winter egg was observed on 13th June. The trees lost their leaves at the end of June, but males were trapped continuously up to 6th September and alate females were especially abundant during July–August, though gynoparae and anholocyclically overwintering migrants, being morphologically indistinguishable, could not be separated. Fundatrices first appeared on 30th July, thus overlapping the flight of the autumn forms, and colonies of fundatrigeniae of the first and second generations were persistent a month later and caused considerable damage to the leaves. The spring migration of fundatrigeniae began at the beginning of October, reached a peak in the middle of that month and was complete by the beginning of November. The number of generations of fundatrigeniae was estimated at 5–7, and migrants were produced mainly in the last two. Parthenogenetic reproduction was also common in the open during the winter, and the continuous production of alate viviparae enabled infestations on cabbage to increase considerably. Alate

alienicolae commonly founded colonies on cabbages planted even during the coldest months (June and July), and reproduction continued actively throughout the winter on many other secondary food-plants. The aphids became scarcer as temperatures rose at the beginning of September and had disappeared from cabbage by October. This type of overwintering is limited by the availability of green foliage, and occurs mainly where plants are watered during the winter, which is dry.

The dates at which the different stages of the autumn, winter and spring forms of *M. persicae* were present during the mild winter conditions of Pretoria and Victoria and the cold ones of western Germany [*cf.* **41** 340], where holocyclic overwintering predominates, as well as the trends in temperature and day-length, are compared from the present and published data. In all three localities, the mean monthly temperature during the four weeks preceding the autumn flight falls from 18°C. [64·4°F.] to about 13·5°C. [56·3°F.]. Winter temperatures in the three localities differ markedly both in the minima reached and the period for which they prevail, however. Findings by Bonnemaison that day-length is of greater importance than temperature in initiating the production of prosexual forms of migrating aphids and that the optima for the development of winged sexuparae and males are 13·5–14 and 12·5–13·5 hours, respectively, were not confirmed, since, although these values are reached in Germany, the day-length before the appearance of the first gynoparae did not exceed 11·3 hours at Pretoria, though the additional radiation and light intensity may be responsible for the difference. The egg stage lasts 6–7 weeks at Pretoria and in Victoria and 12–14 weeks in Germany, and the temperatures at which the fundatrices hatch are about 12, 8·5 and 3°C. [about 53·6, 47·3 and 37·4°F.], respectively. Since the duration of the egg stage is the same at Pretoria and in Victoria, though the prevailing temperature ranges differ, it is suggested that development may be independent of temperature above a threshold lying betwen 3 and 8°C. [46·4°F.]. Peak migration of the fundatrigeniae occurs at about 20°C. [68°F.] at Pretoria, 17°C. [62·6°F.] in Victoria and 13°C. [55·4°F.] in Germany, and the numbers of generations produced are 5–7, 7 and 3. The rate of development is determined by temperature, but the duration of the reproductive period on the primary food-plant seems to depend on morphological or physiological changes in the plant. Bonnemaison suggested that individuals of holocyclic populations may possess an internal factor that, in conjunction with environmental factors, releases the appearance of prosexual forms and males, and F. P. Müller further postulates that where winters are mild a selection process may eliminate this factor; the present investigations indicate, however, that it is more strongly implanted in the gene complex than was supposed. Breeding experiments in progress with clones of *M. persicae* indicate the existence in South Africa of strains differing in physiological behaviour, morphological characters and food-plant preferences.

Müller (F. P.) & Schöll (S. E.). **Some notes on the aphid fauna of South Africa.**—*J. ent. Soc. S. Afr.* **21** no. 2 pp. 382–414, 4 figs., 47 refs. Pretoria, 1958.

Notes are given on 48 named species of aphids, many of which attack plants of economic importance, that were collected by the junior author at Pretoria and elsewhere in South Africa. The information given for each varies in scope, but includes localities, dates, food-plants, world distribution, distribution in South Africa, economic importance, distinguishing characters and nomenclature, including notes on synonymy. Of the aphids listed,

Macrosiphum rosae (L.), *Capitophorus* (*Myzaphis*) *rosarum* (Kalt.), *Hyadaphis foeniculi* (Pass.), *Capitophorus* (*Pentatrichopus*) *tetrarhodus* (Wlk.) and *Brevicoryne brassicae* (L.) produce sexual forms in autumn in central and northern Europe, but have been shown by W. Cottier in work noticed earlier [*R.A.E.*, A **41** 410] to reproduce viviparously throughout the winter in New Zealand, when suitable foliage is available. In view of the mild climate of South Africa, only continuous parthenogenetic reproduction might be expected, but sexual forms of *B. brassicae* and *Aphis* (*Rhopalosiphum*) *maidis* Fitch have been observed. It is not known whether their occurrence is exceptional and of little importance or whether both sexual and parthenogenetic reproduction are of normal occurrence, as in *Myzus persicae* (Sulz.) [see preceding abstract]. Other aphids may also overwinter holocyclically, since fundatrices have been found, but the migratory species, *H. foeniculi*, *Anuraphis* (*Brachycaudus*) *helichrysi* (Kalt.), *Rhopalosiphum nymphaeae* (L.), *Hyalopterus pruni* (Geoffr.) (*arundinis*, auct.) and *Aphis fabae* Scop. have been taken only on secondary food-plants. Biological strains that continue to reproduce parthenogenetically, even under extreme autumn conditions, are known to exist in *M. persicae* [see preceding abstract], *Macrosiphum* (*Aulacorthum*) *solani* (Kalt.) and other aphids and probably also occur in still others, including *Anuraphis helichrysi* and *R. nymphaeae*. There therefore appears to be a transitional zone in some parts of South Africa in which, in some species, strains that overwinter holocyclically and anholocyclically coexist.

Hoffmann (A.). **Description de deux anthribides nouveaux nuisibles au caféier.**—*J. Agric. trop. Bot. appl.* **6** no. 6–7 pp. 340–343, 2 figs., 1 ref. Paris, 1959.

The two Anthribids described, for which a new genus, *Branconymus*, is erected, are *B. vayssierei* (the type species) and *B. pujoli*, spp.n. Both attack coffee, the first in San Thomé, Gulf of Guinea, and the second in the Ivory Coast. The larvae of *B. vayssierei* were found mining the young shoots in nurseries in September 1958, and the damage was considerable. Other Anthribids that occur in San Thomé are noted.

de Luca (Y.). **Sur l'identité spécifique de** *Bruchidius trifolii* **Motsch. et** *Bruchidius alfieri* **Pic (Col. Bruchidae).**—*Ann. Ec. nat. Agric. Alger* **1** fasc. 2, 19 pp., 30 figs., 18 refs. Algiers, 1958.

Varying numbers of individuals in populations of *Bruchidius trifolii* (Motsch.) found infesting the seeds of *Trifolium alexandrinum* in Algeria were found to be referable to *B. alfierii* (Pic), which has not previously been known outside Egypt and has been considered a form of *B. trifolii* [*cf. R.A.E.*, A **46** 26, etc.]. A morphological study of the insects concerned, including their genitalia, the results of which are given in detail, confirmed that *B. alfierii* is not specifically distinct from *B. trifolii*, the only difference being in the colour of the legs and antennae.

Dutt (N.). *Anomis sabulifera* **Guen. and** *Apion corchori* **Marsh.—incidences and control.**—*Jute Bull.* **21** no. 5 repr. 8 pp., 5 refs. Calcutta, 1958.

Fibre yields of jute (*Corchorus olitorius* and *C. capsularis*) at Tarakeswar, in the Hooghly district of West Bengal, were decreased by about 14 per cent. in 1951–52 as a result of damage by insects and mites. Observations

over 93 acres of *C. olitorius* in 1954, when conditions were normal, showed that infestation by *Spodoptera* (*Laphygma*) *exigua* (Hb.) [*cf. R.A.E.*, A **34** 163], *Anomis sabulifera* (Gn.), *Apion corchori* Mshl., *Nupserha bicolor postbrunnea* Breun. [*cf.* **44** 428], and *Hemitarsonemus latus* (Banks) reached 1–3 per cent. on 7·17, 42·63, 13·11, 57·43 and 23·56 per cent., respectively, of the area and 4–20 per cent. on 0·36, 15·3, 0·41, 4·23 and 1·79 per cent. of it, while some parts were even more heavily infested by *Anomis*, *Nupserha* and *H. latus*.

Anomis sabulifera is the most important mid-season pest. It prefers the younger leaves of the plant, the leaf-buds and the shoot apex [*cf.* **29** 447], and dusts give erratic control when applied in such exposed situations. In tests of sprays, the deposit from 0·75 per cent. wettable DDT gave complete kill of first- and fourth-instar larvae in 1 and 5 hours, respectively, and a large-scale test was therefore carried out in 1957 in which the spray was applied on 7th July at 40 gal. per acre. Although 40 per cent. of the larvae disappeared after spraying, only 1·04 per cent. of the total were found alive after 48 hours. The numbers had increased again 18 days later, and a second application gave similar results. Laboratory tests with third- and fourth-instar larvae had shown that 0·4 per cent. wettable aldrin or dieldrin was less effective than 0·75 per cent. DDT, whereas an endrin emulsion concentrate and a proprietary parathion preparation (Folidol E-605) at 0·03 and 0·009 per cent. toxicant, respectively, were superior to it. At 0·01 per cent., parathion killed all final-instar larvae within 21 hours, but at 0·005 and 0·0075 per cent., about a quarter survived and produced viable pupae. Parathion was not tested in the field, because of toxicity hazards, but endrin was tested in July 1957; 0·03 per cent. endrin in an emulsion spray gave almost complete mortality in 48 hours, but persisted for less than two weeks, a second application being then required and giving complete kill. The toxicity of endrin to fish is a disadvantage in low-lying districts. Measures effective against *A. sabulifera* also control *S. exigua*, which attacks seedling jute, and *Diacrisia obliqua* (Wlk.), which is sometimes injurious late in the season.

The larvae of *Apion corchori* damage the fibres within the stem, although minor injury is sometimes done to pods and immature seeds. The nodal region below a leaf-base was found to be selected as the feeding site in 37·11 and 65·93 per cent. of plants of branching and non-branching varieties of *C. capsularis*, respectively; that species was attacked slightly more frequently than *C. olitorius* during the first nine weeks of crop growth, but the position was reversed by the end of the season. As the weevil completes its life-cycle within the stem [*cf.* **29** 446], cultural and mechanical methods have been recommended for its control, but a test of parathion showed that 83·11 per cent. of the larvae were killed in 48 hours by a 0·01 per cent. spray. Such an application could be used to control both *A. corchori* and *Anomis*.

Ishikura (H.) & Ozaki (K.). **Continuous mass rearing of the cabbage armyworm, *Barathra brassicae* Linnaeus, and the studies on the resistance of the reared armyworm to certain insecticides.** [*In Japanese.*]—*Bull. nat. Inst. agric. Sci.* (C) no. 10 pp. 1–42, 1 pl., 9 figs., 129 refs. Tokyo, 1958. (With a summary in English.)

In investigations in Japan, *Mamestra* (*Barathra*) *brassicae* (L.) was reared successfully on its natural food-plants from the egg to the third larval instar in petri dishes and in the later instars in wooden boxes, which absorbed excess moisture. The larvae were maintained in light or darkness continuously to prevent diapause or for alternating 12-hour periods to induce it

[*cf. R.A.E.*, A **47** 33], and transferred to a box containing moist soil or sand and kept at a temperature of 25°C. [77°F.] when full-fed. The pupal stage lasted 25–50 days at 25°C. for insects not entering diapause, and such pupae were kept after a week in petri dishes containing moist cotton. Larvae entering diapause were preferably put in cold storage to terminate the diapause; the adults appeared simultaneously after the pupae had been transferred to higher temperatures. For oviposition, pairs of adults were kept in petri dishes lined with soft paper, on which the eggs were deposited; they were fed with 5 per cent. sucrose. The eggs hatched in four days at 25°C. and could be kept at 10°C. [50°F.] for two weeks without ill effects.

When larvae were reared in groups of 10, 20 or 40 per dish and at temperatures of 20, 25 and 30°C. [68, 77 and 86°F.], either increasing the numbers or raising the temperature resulted in higher mortality and in lower and more variable larval weights. Larvae reared on turnip or Chinese cabbage increased in weight more rapidly than those on cabbage, radish (daikon) or rape, but the difference in mature weight was only slight.

In tests of insecticides on the larvae, resistance to EPN, measured by the time required for 50 per cent. mortality of larvae in contact with impregnated paper, decreased with larval weight; the decrease was proportional to the decrease in weight caused by temperature increase, but was greater than that caused by density increase. Insects reared on radish were most and those on rape least resistant. When dipped in a parathion emulsion during the third or fourth instar, larvae reared on turnip were significantly more resistant than those reared on cabbage; resistance increased with age until the early sixth instar, but decreased thereafter. Resistance to methyl-parathion, applied topically in acetone during the fifth moult or early or late in the sixth instar, decreased as the rearing temperature rose.

It is concluded that larvae in the fifth instar are the most suitable for use in insecticide tests.

Wilson (G. F.). **Horticultural pests: detection and control.** Third edition revised by P. Becker.—$8\frac{3}{4} \times 5\frac{1}{2}$ in., xix + 240 pp., frontis., 4 col. pls., 146 figs., 22 refs. London, Crosby Lockwood & Son, Ltd., 1960. Price £1 5*s*.

This revised edition of the late G. Fox Wilson's book on the detection and control of the insects and other invertebrates that attack greenhouse and garden plants, including vegetables and fruit trees and bushes, in Britain [*R.A.E.*, A **35** 270] preserves the arrangement of the original work, but has been expanded to include up-to-date control methods based on modern toxicants, information on a few new pests and some that have assumed increased importance, and a short chapter on pests of lawns. Appendices and coloured plates have been added.

Papers noticed by Title only.

Loomis (E. C.). **A method for more accurate determination of air volume displacement of** [suction] **light traps.**—*J. econ. Ent.* **52** no. 2 pp. 343–345, 1 fig., 4 refs. Menasha, Wis., 1959. [*Cf. R.A.E.*, B **48** 124.]

Bärner (J.). **Bibliographie der Pflanzenschutzliteratur. Bibliography of plant protection . . . 1953.**—xli + 527 pp. Berlin, P. Parey, 1960. [*Cf. R.A.E.*, A **47** 512, etc.]

The Injurious Insects of the British Commonwealth

(except the British Isles, India and Pakistan).

By J. W. EVANS, M.A., Sc.D., D.Sc.

Royal 8vo. vii and 242 pp. Bound in cloth. Price 30*s*. post free.

This work consists of five parts:—

Part 1 gives a brief outline of the environmental conditions and principal crops of each country in the Commonwealth followed by titles of comprehensive publications and a list of the more important insect pests of plants. Insects and ticks of medical and veterinary importance are also briefly discussed.

Part 2 consists of the more important plant pests and their distribution, listed under the crops arranged in alphabetical order.

Part 3 comprises the insects arranged in alphabetical order of genera and species under their respective orders with brief information and references relating to each insect.

Part 4 deals with weed control by insects and is arranged under the weeds in alphabetical order.

Part 5 deals very briefly with plant quarantine, virus vectors, insect control and research needs.

Orders should be addressed to **The Director, Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7.**

A CRITICAL REVIEW
of the
TECHNIQUES FOR TESTING INSECTICIDES

By Dr. J. R. BUSVINE

Bound in cloth. *Royal 8vo.* *Pages x and 208 with 50 text figures.*
Price 30s. post free.

The discovery of DDT and a wide range of other powerful new insecticides has made possible considerable advances in controlling insect pests. Before these can be used on a large scale extensive laboratory tests have to be carried out. Their use has, however, been followed in some cases by the development of resistance on the part of the pest treated. Satisfactory techniques for measuring resistance are essential if comprehensive information about existing resistant strains and warning of the emergence of new ones is to be obtained.

The present work is a review of the techniques that have been used for testing insecticides, giving special attention to the influence of the physiological condition of the insects and various physical and mechanical factors which may affect the results. A clear understanding of these matters is required to permit the development of satisfactory standardised methods, with particular reference to insecticide resistance. The book contains 12 chapters as follows:—

1. General principles of insecticide testing.
2. Handling insects in insecticide tests.
3. Standardisation of insects for testing. Part 1—Insecticides: Part 2—Repellents.
4. Stomach poison insecticides.
5. Contact poisons in powder form.
6. Immersion methods.
7. Laboratory spraying apparatus.
8. Apparatus for injection or application of insecticides to individual insects.
9. Exposure of insects on residual films of contact insecticides.
10. Fumigants.
11. Insect repellents.
12. Toxicological statistics.

Also included are an Introduction, Conclusions and a list of over 550 references.

Obtainable from:—The Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7.

THE ASSOCIATION OF ANTS WITH APHIDS AND COCCIDS

By G. E. J. NIXON, B.A.

(With a Foreword by W. J. Hall, C.M.G., M.C., D.Sc.)

A review of the literature with special reference to the rôle of the ants where the association is believed to be connected with the transmission of crop diseases.

Royal 8vo. 36 pp. Paper Covers. Price 5s. post free.

Orders should be addressed to *The Director, Commonwealth Institute of Entomology, 56, Queen's Gate, London, S.W.7.*

INDEX OF AUTHORS

Adlerz, W. C., 294.
Anderson, J. F., 304.
Armstrong, M. T., 281.

Bärner, J., 316.
Barnes, M. M., 295.
Barnes, O. L., 303.
Becker, P., 316.
Beroza, M., 284.
Bibby, F. F., 286.
Bodenstein, G., 279.
Brazzel, J. R., 298, 299, 305.
Bushland, R. C., 283.

Carlson, E. C., 291.
Carter, R. H., 289.
Cartier, J. J., 297.
Casida, J. E., 294.
Cass, L. M., 288.
Cassil, C. C., 285.
Chada, H. L., 295.
Chamberlain, W. F., 296.
Chiang, H. C., 297.
Coggins, R. E., 281.
Cunningham jr., W. H., 302.

Daiber, C. C., 312.
Dean, H. A., 289.
de Jong, D. J., 280.
de Luca, Y., 314.
Dicke, R. J., 289, 290.
Dietrick, E. J., 292.
Dolinka, B., 277.
Doucette, C. F., 306.
Dutt, N., 314.
Düzgüneş, Z., 284.

Ebeling, W., 286, 287.
Eidmann, H., 278.
English, L. L., 307.
Esin, T., 285.

Foley, F. B., 291.
Fullmer, O. H., 285.
Fye, R. E., 298, 299.

Gaines, J. C., 298.
Gatterdam, P. E., 294.
Genç, B., 285.
Gillenwater, H. B., 288.
Green, H. B., 306.
Green, N., 284.
Grigarick, A. A., 307.

Hall, S. A., 284.
Harcourt, D. G., 288.
Harding, J. A., 308.
Hassan, S., 308.
Henneberry, T. J., 305.
Heuser, S. G., 283.
Hewlett, P. S., 284.
Hill, E. G., 281.
Hodson, A. C., 297.
Hoffman, A., 314.
Hopkins, A. R., 298, 299.
Hornstein, I., 294.

Ishikura, H., 315.

Kaloostian, G. H., 309.
Kantack, B. H., 288.
Kearns, C. W., 284.
King, D. R., 302.
Kirk, V. M., 303.
Kurtz, E. A., 285.

Langley, B. C., 302.
Laudani, H., 288.
Laughlin, R., 281.
Lichtenstein, E. P., 296.
Lindgren, D. L., 300, 301.
Lipke, H., 284.
Loomis, E. C., 316.
Lyon, R. L., 301.

McMillian, W. W., 299.
Manson, G. F., 306.
Martin, D. F., 299.
Marzke, F. O., 289, 290.
Metcalf, R. L., 283, 284.
Miles, J. R. W., 306.
Milne, A., 281.
Miskus, R., 308.
Mitchell, J. W., 284.
Mulkern, G. B., 304.
Müller, F. P., 313.
Müller-Bastgen, G., 279.

Neiswander, R. B., 293.
Nickel, J. L., 292.

Öden, T., 285.
Oosthuizen, M. J., 310.
Ortega, J. C., 295.
Ozaki, K., 315.

Phelps, R. J., 310.
Phillips, M. F., 288.
Pieper, G. R., 308.
Polivka, J. B., 296.
Pollard, H. N., 309.
Post, J. J., 280.
Price, D. W., 304.
Puttler, B., 302.

Riehl, L. A., 302.

Savescu, A., 277.
Sbur, D. E., 308.
Schlinger, E. I., 292.
Schöll, S. E., 312, 313.
Secrest, J. P., 287.
Sentürk, I., 285.
Sipahi, R., 285.
Smale, B. C., 284.
Smith, F. F., 305.
Steinhaus, E. A., 307.
Stone, M. W., 291.
Stoutamire, D. W., 294.
Strong, R. G., 301, 308.
Sullivan, W. N., 294, 298.
Summers, F. M., 304.
Sylvester, E. S., 292.

Taylor, E. A., 305.
Thomas, C. A., 294.
Thompson, C. G., 298.
Thornton, D. G., 287.
Turner, W. F., 309.
Tuttle, D. M., 286.

van den Bosch, R., 292, 302.
Vanderplank, F. L., 311.
Vasiljević, L. A., 277.
Vincent, L. E., 300.
v.Scheller, H. D., 278.

Wagner, R. E., 286, 287.
Walker jr., J. K., 305.
Walker, R. L., 298, 299.
Wallis, R. L., 289.
Weaver, C. R., 290.
Wedding, R. T., 302.
Weigel, C. A., 294.
Whitnall, A. B. M., 309.
Williams, R. E., 293.
Wilson, G. F., 316.
Winteringham, F. P. W., 284.
Wright, C. G., 309.

NOTICES

Secretaries of Societies and Editors of Journals willing to exchange their publications with those of the Institute are requested to communicate with the Director. Authors of papers on economic entomology, whether published in entomological journals or not, are invited to send reprints to the Director for notice in the *Review*.

The Executive Council of the Commonwealth Agricultural Bureaux is a signatory to the Fair Copying Declaration, details of which can be obtained from the Royal Society, Burlington House, London, W.1.

The Commonwealth Agricultural Bureaux Organisation does not accept responsibility for any trade advertisements in this Journal.

CONTENTS.

PAGE

AFRICA: Resistance to organophosphates in *Tetranychus* in South Africa ... 309
AFRICA: Insects injurious to cowpeas in Natal 310
AFRICA: A Reduviid preying on *Oryctes* on coconut in Zanzibar 311
AFRICA: The overwintering of *Myzus persicae* in South Africa 312
AFRICA: Notes on the aphids of South Africa 313
AFRICA: Two new Anthribids on coffee 314
AFRICA: The species of *Bruchidius* on *Trifolium alexandrinum* in Algeria ... 314
BRITAIN: Methods of sampling for Tipulid larvae in turf 281
BRITAIN: BHC in whitewash against *Ephestia elutella* in warehouses ... 281
BRITAIN: Horticultural pests: detection and control (*Review*) 316
CANADA: Control of Lepidopterous larvae on cabbage 288
CANADA: Biotypes of *Macrosiphum pisum* in Quebec 297
GERMANY: Effects of treatments against *Coleophora laricella* 278
GERMANY: Tests of Kelthane against various mites 279
HOLLAND: Influence of temperature on pupation and emergence of *Cydia pomonella* 280

[*Continued on p. iv of cover*

CONTENTS—*cont.*

PAGE

HUNGARY: *Cydia compositella* infesting lucerne 277
INDIA: Pests of jute and their control 314
JAPAN: Rearing *Mamestra brassicae* and testing insecticides on it 315
RUMANIA: A new species of *Lepidosaphes* on *Tilia* 277
SWEDEN: *Dryophilus pusillus* infesting larch 278
TURKEY: *Tetranychus tumidellus* found on groundnuts 284
TURKEY: DDT residues on cherries 285
TURKEY: *Trogoderma granarium* and its control 285
TURKEY: *Pachypasa otus* on pistachio 285
U.S.A.: Phostex against *Eriophyes pyri* on pear 285
U.S.A.: List of mites taken in Arizona 286
U.S.A.: Sorptive dusts and other desiccants against *Kalotermes minor* 286, 287
U.S.A.: Comparison of insecticides against *Choristoneura fumiferana* ... 287
U.S.A.: Synergised pyrethrum protecting dried *Citrus* pulp from insects ... 288
U.S.A.: Seasonal distribution of mites on grapefruit in Texas 289
U.S.A.: Residues of methoxy-DDT on vegetable crops 289
U.S.A.: Evaluation of sprays against Dermestids that infest dried milk ... 289
U.S.A.: Comparison of sprays against cheese mites 290
U.S.A.: Egg development in *Philaenus* and Hopkins' bioclimatic law ... 290
U.S.A.: *Liorhyssus hyalinus* on lettuce seed crops in California 291
U.S.A.: DDT treatments against *Lygus* on lima beans in California ... 291
U.S.A.: A predacious earwig in lucerne fields in California 292
U.S.A.: Investigations on toxic feeding by *Therioaphis maculata* 292
U.S.A.: The control of *Agrilus anxius* and *Chrysobothris femorata* 293
U.S.A.: Insecticide vapours controlling mushroom flies 294
U.S.A.: Technique for testing resistance of cereals to *Toxoptera graminum* 295
U.S.A.: Protein hydrolysate bait-sprays against *Rhagoletis* on walnut ... 295
U.S.A.: Distribution of egg-masses of *Ostrinia nubilalis* on maize 297
U.S.A.: Toxicity of insecticides to eggs and larvae of *Pectinophora gossypiella* 298
U.S.A.: Residual effects of phorate and Bayer 19639 against aphids 298
U.S.A.: Overwintering and emergence of *Pectinophora gossypiella* in Texas 299
U.S.A.: Penetration into woods by hibernating *Anthonomus grandis* ... 299
U.S.A.: Notes on the bionomics and control of *Trogoderma granarium* ... 300
U.S.A.: Toxicity of insecticides to Californian bark-beetles 301
U.S.A.: Sprays against *Elasmopalpus lignosellus* on groundnuts 302
U.S.A.: Effect of oil emulsion on transpiration of *Citrus* leaves 302
U.S.A.: Cultural practices and grasshopper populations on lucerne 303
U.S.A.: Insecticidal control of *Heliothis zea* on sorghum heads 303
U.S.A.: Spring activity of overwintered larvae of *Anarsia lineatella* 304
U.S.A.: Technique for studying the food preferences of grasshoppers ... 304
U.S.A.: Tests of chlorbenside, chlorfenson and Tedion against *Tetranychus* 305
U.S.A.: Winter survival of autumn-collected adults of *Anthonomus grandis* 305
U.S.A.: Mortality of *Solenopsis saevissima richteri* due to cold 306
U.S.A.: Soil drenches controlling *Merodon equestris* 306
U.S.A.: A trap for sampling adults of *Hydrellia griseola* 307
U.S.A.: Granulosis viruses in two Alaskan insects 307
U.S.A.: Dibrom against larvae of *Thyridopteryx ephemeraeformis* 307
U.S.A.: Acaricides not reducing germination of flower seeds 308
U.S.A.: Insecticides against *Macrosiphum euphorbiae* on tomato 308
U.S.A.: Insecticides against *Lyctus planicollis* 309
U.S.A.: The spread of *Homalodisca insolita* 309
YUGOSLAVIA: Bacteria pathogenic to *Hyphantria cunea* 277
Sorption of fumigants under atmospheric and reduced pressure 283
Advances in pest control research, Vol. III (*Review*) 283
Factors affecting transmission of bean yellow mosaic virus 294
Relation of structure to the properties of substituted-vinyl phosphates ... 294
Tests of repellents against agricultural insects 296
Persistence of chlorinated hydrocarbons in turf soils 296
Survival of insect eggs after flights on jet aircraft 298
Effects of fumigants on the germination of barley 301
Partial immunity of *Spodoptera exigua* to *Hyposoter exiguae* 302
Rubber latex for determining deposits on surfaces of leaves 306
Method of determining phorate residues 308
Determination of air displacement of suction light-traps (*Title only*) ... 316
A bibliography of plant protection for 1953 (*Title only*) 316

Printed in Great Britain by The Eastern Press, Ltd., London and Reading